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PROVISIONAL MORTALITY RATES FOR THE FIRST SIX MONTHS OF 1938

The mortality rates in this report are based upon preliminary data for 42 States, the District of Columbia, Alaska, and Hawaii for the first 6 months of 1938. Comparative data for 39 States (District of Columbia included as a State) are presented for the first 6 months and by the 2 quarters of 1938 and 1937.

This report is made possible through a cooperative arrangement with the respective States, which voluntarily furnish provisional quarterly and annual tabulations of current birth and death records. These reports are compiled and published by the United States Public Health Service.

Because of lack of uniformity in the method of classifying deaths according to cause, and because a certain number of certificates were not filed in time to be included, these data may differ in some instances from the final figures subsequently published by the Bureau of the Census.

In the past, these preliminary reports have provided an early and accurate index of the trend in mortality for the country as a whole. Some deviation from the final figures for individual States is to be expected, because of the provisional nature of the information. It is believed, however, that the trend of mortality within each State is correctly represented. Comparisons of specific causes of death among different States are subject to error because of differences in tabulation procedure and completeness of reporting. Comparisons of this nature should be made only from the final figures published by the Bureau of the Census.

Unless there is a marked reversal of trend, the mortality rate from all causes of death during the current year will be the lowest on record with the possible exception of 1933, when the death rate was 10.7 per 1,000 population. The rate for the first 6 months of 1938, 10.8 per 1,000 population, is only slightly higher than the low rate for 1933 and represents a decrease of 8.5 percent from the rate for 1937. Every State for which data are available reported a lower rate than for 1937.

Although this decrease in the mortality rate is reflected in nearly all the important causes of death, about 60 percent is accounted for by the decreased prevalence of influenza and pneumonia, especially during the first quarter of the year. The death rate from influenza for the first half of 1938 is only one-third of the rate for 1937, and that

from pneumonia is only three-fourths the rate for the corresponding period last year.

The downward trend of the death rate from tuberculosis continues unchecked and the current rate is 10 percent less than the corresponding rate for 1937. It is possible that the rate for 1938 will drop below 50 per 100,000 for the first time.

The decline in maternal mortality has been even greater than that from tuberculosis; the current rate, 4.4 per 1,000 live births, is 15 percent less than the corresponding rate for 1937.

The widespread efforts to prevent traffic accidents are apparently achieving success, since the mortality rate from automobile accidents for the half year is 20 percent less than the rate for the similar period of 1937. This decrease is widespread, only 4 of the States reporting a higher rate than for last year.

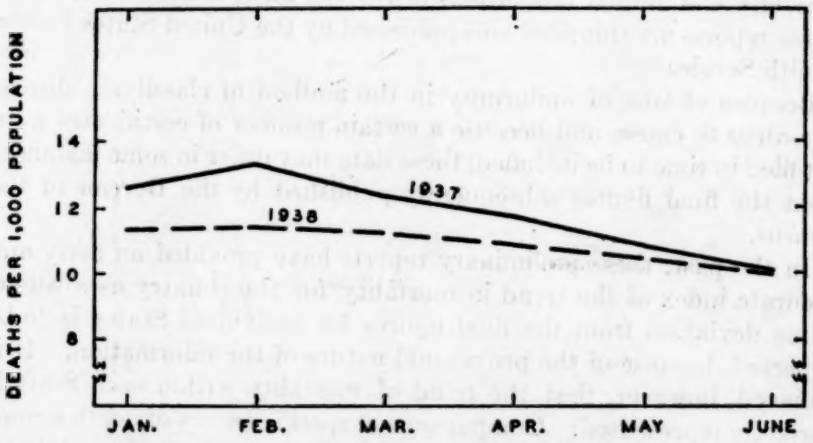

FIGURE 1.—Death rate per 1,000 population, by months, 1937 and 1938.

The only important cause of death for which the current rate is greater than that for 1937 is cancer, for which an increase of about 3 percent is reported.

The serious outbreak of measles which occurred last winter continued into the second quarter of this year. As a result, the death rate, 4.5 per 100,000 population, is more than 4 times the corresponding rate for 1937. Slight increases also occurred in the mortality rates for whooping cough and for diarrhea and enteritis under 2 years of age.

Another outstanding feature of the mortality record for the first 6 months of 1938 was the widespread decline in the infant mortality rate. Only 5 States reported a higher rate than for 1937, and the current rate is nearly 9 percent less than that for last year.

The birth rate for 1938 has continued slightly above that for 1937. This increase, combined with a lower death rate, has resulted in a crude rate of natural increase of 6.0 per 1,000 population, compared with the corresponding rate of 4.3 per 1,000 population for 1937.

Provisional mortality rates from certain causes in the first 6 months of 1938, with comparative provisional data for the corresponding period in preceding years

State and period	All causes, rate per 1,000 population (annual basis)	Births (exclusive of stillbirths) per 1,000 population (annual basis)	Rate per 1,000 live births		Death rate per 100,000 population (annual basis)																		
			Total infant mortality	Maternal mortality	Typhoid fever (1, 2)	Measles (7)	Scarlet fever (8)	Whooping cough (9)	Diphtheria (10)	Influenza (11)	Acute poliomyelitis and polioencephalitis (16)	Encephalitis, epidemic or lethargic (17)	Epidemic cerebrospinal meningitis (18)	Tuberculosis, all forms (23–32)	Cancer, all forms (45–53)	Diabetes (59)	Cerebral hemorrhage, apoplexy (82a, b)	Diseases of the heart (90–95)	Pneumonia, all forms (107–109)	Diseases of the digestive system (115–129)	Diarrhea and enteritis, under 2 years (119)	Nephritis (130–132)	All accidents (176–195, 201–214)[1]	Automobile accidents (206, 208, 210)[1]
39 STATES[2]																							
January–June:																							
1938	10.8	16.8	52	4.4	1.0	4.5	1.4	3.9	1.5	16.1	0.3	0.6	1.0	48.8	112.4	24.8	86.5	272.4	81.9	60.1	7.3	80.9	64.4	19.9
1937	11.8	16.1	57	5.2	1.0	1.0	2.1	3.2	1.6	48.2	.3	.7	2.2	54.2	108.9	25.1	89.2	274.9	111.8	61.0	6.0	84.3	73.8	24.9
January–March:																							
1938	11.3	16.6	53	4.5	.8	4.4	1.7	3.5	2.0	23.2	.3	.6	1.2	48.0	112.0	26.1	89.6	284.1	103.9	55.1	4.2	83.1	63.8	20.2
1937	12.7	15.7	64	5.6	.9	.7	2.6	3.2	2.2	75.8	.3	.7	2.6	54.6	108.4	27.8	94.5	294.4	147.6	58.7	4.5	87.3	71.7	24.5
April–June:																							
1938	10.4	16.9	50	4.4	1.2	4.7	1.0	4.2	1.0	9.2	.3	.6	.8	49.6	112.9	23.6	83.5	269.9	60.2	65.0	10.5	78.8	64.9	19.6
1937	10.9	16.4	51	4.9	1.1	1.3	1.7	3.1	1.1	20.9	.3	.6	1.9	53.8	109.5	22.4	84.0	255.7	76.5	63.3	7.6	81.4	75.9	25.2
Metropolitan Life Insurance Co., industrial policyholders, ages 1 and over (January–June):[3]																							
1938	8.1	------	------	------	.8	2.9	1.7	2.2	1.7	9.9	------	------	------	49.0	96.1	26.2	61.2	[4] 162.4	66.0	------	[5] 5.9	[6] 56.1	45.5	16.2
1937	9.0	------	------	------	.6	1.4	2.1	3.1	1.8	30.4	------	------	------	54.8	93.4	27.4	62.2	[4] 173.3	93.8	------	[5] 5.6	[6] 58.8	50.2	19.1

[1] Data not compiled for these causes prior to 1937.
[2] Includes all States with data for the 6-month period of 1937 and 1938. Estimated population July 1, 1938: 105,575,000.
[3] These data are taken from the Monthly Statistical Bulletin published by the Metropolitan Life Insurance Co. The figures are subject to correction, since they are based on provisional estimates of lives exposed to risk (17,700,000 persons in 1938). Data does not include all diseases reported to the Public Health Service.
[4] Excludes pericarditis, acute endocarditis, acute myocarditis, coronary artery diseases, and angina pectoris.
[5] Classified as diarrhea and enteritis, age not specified.
[6] Chronic nephritis (Bright's disease) only.

Provisional mortality rates from certain causes in the first 6 months of 1938, with comparative provisional data for the corresponding period in preceding years—Continued

State and period	All causes, rate per 1,000 population (annual basis)	Births (exclusive of stillbirths) per 1,000 population (annual basis)	Rate per 1,000 live births		Death rate per 100,000 population (annual basis)																		
			Total infant mortality	Maternal mortality	Typhoid fever (1, 2)	Measles (7)	Scarlet fever (8)	Whooping cough (9)	Diphtheria (10)	Influenza (11)	Acute poliomyelitis and polioencephalitis (16)	Encephalitis, epidemic or lethargic (17)	Epidemic cerebrospinal meningitis (18)	Tuberculosis, all forms (23–32)	Cancer, all forms (45–53)	Diabetes (59)	Cerebral hemorrhage, apoplexy (82a, b)	Diseases of the heart (90–96)	Pneumonia, all forms (107–109)	Diseases of the digestive system (115–129)	Diarrhea and enteritis, under 2 years (119)	Nephritis (130–132)	All accidents (176–195, 201–214) [1]	Automobile accidents (206, 208, 210) [1]
JANUARY–JUNE																							
Alabama:																							
1938	10.7	21.2	65	6.6	1.7	10.4	0.7	6.9	2.3	36.2	0.5	0.8	3.1	57.2	54.8	11.9	71.2	167.7	91.5	69.1	19.6	78.9	64.2	18.0
1937	11.4	20.8	71	6.6	1.2	.1	.3	6.5	2.4	82.8	.6	.3	5.2	65.3	57.1	11.0	68.5	164.9	117.0	57.0	13.1	79.4	70.3	20.2
1936	11.6	21.3	71	6.5	.8	1.2	.5	2.6	2.7	82.2	.4	.1	1.1	68.2	56.1	12.6	69.3	152.2	139.2	59.7	13.2	82.4	------	------
Alaska:																							
1938	24.0	31.6	(7)	(7)	3.2	3.2	3.2	96.0	(3)	67.2	(3)	(3)	(3)	582.6	96.0	(3)	182.4	252.9	284.9	51.2	(3)	16.0	227.3	(3)
1937	18.8	22.7	141	10.1	(3)	6.7	(3)	37.0	(3)	53.8	(3)	(3)	6.7	379.8	67.2	6.7	60.5	369.7	198.3	63.8	10.1	23.5	164.7	(3)
California: [9]																							
1938	13.1	15.6	47	3.0	1.2	1.4	.6	2.3	1.9	7.6	.2	.4	1.2	71.7	144.0	26.3	96.6	389.0	89.8	75.4	7.4	88.7	89.9	38.4
1937	16.3	14.3	58	4.8	.7	.6	1.2	4.4	1.9	69.3	.1	.6	3.6	91.3	144.0	32.6	101.6	478.3	160.4	83.8	5.3	96.1	111.0	49.8
1936	13.6	13.0	51	5.1	.3	4.9	2.6	1.0	2.6	27.3	.3	.6	3.0	83.4	141.3	27.4	94.8	378.0	105.3	77.3	4.4	91.8	------	------
Colorado:																							
1938	11.9	18.7	53	4.6	1.3	5.1	1.3	3.0	3.9	17.6	.8	.8	.8	67.2	119.1	18.8	91.0	246.3	117.0	74.1	6.6	87.8	80.7	26.1
1937	14.3	17.9	73	5.8	1.3	.2	2.3	6.2	2.4	86.0	1.9	1.3	3.8	73.2	122.4	17.5	92.8	242.0	244.8	81.2	4.9	86.0	87.4	27.9
Connecticut:																							
1938	10.5	13.4	36	2.5	.2	(3)	.5	.6	.9	5.1	(3)	.2	.2	37.9	137.0	31.9	91.6	261.9	66.9	50.8	2.6	87.1	59.3	16.8
1937	10.9	12.6	45	3.3	.3	1.3	1.2	1.7	.9	20.0	(3)	.5	.9	38.8	125.6	34.8	86.0	246.1	59.9	49.9	3.6	87.6	64.4	21.8
1936	10.9	12.5	47	4.9	.1	.7	.8	2.9	.3	13.4	.1	.3	1.3	40.6	128.7	32.0	(7)	247.2	99.6	(7)	2.9	96.5	------	------
Delaware:																							
1938	12.6	15.7	53	3.9	.8	1.5	.8	8.5	1.5	16.2	(3)	(3)	.8	43.9	127.0	31.6	110.8	384.1	97.8	57.7	6.2	120.1	73.1	24.6
1937	14.4	15.9	67	3.9	1.5	2.3	(3)	7.7	.8	36.3	(3)	(3)	3.1	55.6	108.9	30.9	103.5	385.5	129.8	66.4	7.0	144.5	106.6	39.4
District of Columbia:																							
1938	13.1	19.7	49	5.3	.3	.6	1.0	.6	1.0	6.4	(3)	1.0	2.5	74.9	137.2	22.5	87.6	353.4	108.9	69.5	7.6	112.1	67.0	19.1
1937	15.2	19.0	65	6.8	1.0	3.8	1.0	4.5	3.2	28.6	(3)	1.0	7.7	102.0	144.4	32.2	104.2	346.4	166.3	77.2	5.8	98.7	81.0	26.7
1936	15.8	18.4	72	5.6	1.9	2.3	.6	5.5	6.5	13.0	.3	.6	14.6	114.4	132.5	33.5	111.1	370.7	177.4	77.6	5.8	102.7	------	------
Florida:																							
1938	12.9	16.1	62	7.8	3.4	2.5	0.1	4.4	1.9	29.6	0.4	0.6	1.1	58.9	95.0	20.7	106.1	273.3	79.9	95.0	15.6	101.0	99.3	42.4
1937	13.1	15.9	64	7.4	3.4	.4	.1	3.3	2.4	51.2	.2	.4	6.6	59.4	96.7	20.4	108.1	253.6	81.1	94.5	13.4	103.4	107.5	41.4
1936	13.3	15.1	64	9.1	2.4	.4	.1	1.7	2.8	79.4	.7	.5	3.3	54.1	87.9	21.7	106.9	257.6	105.3	83.5	8.2	110.1	------	------

Georgia:																								
1938	10.7	19.0	73	6.7	2.2	7.9	.5	7.1	1.6	33.4	.4	.2	1.0	52.3	56.4	13.4	85.8	165.9	101.4	70.1	20.4	108.9	3.6	23.2
1937	10.9	18.7	66	7.7	2.0	.1	.3	3.4	2.0	70.0	.6	.2	1.7	49.9	54.1	11.3	84.7	167.4	107.8	63.4	12.9	104.1	67.9	25.7
1936	11.8	18.5	70	7.5	3.0	.3	.3	2.0	2.4	96.5	.3	.4	3.0	55.4	53.2	11.2	80.1	173.5	151.4	61.3	9.7	103.5	------	------
Hawaii:																								
1938	7.3	20.0	58	2.8	1.3	.4	.4	5.7	.9	4.4	.9	.4	.4	61.2	44.9	15.8	51.5	111.8	62.1	53.7	13.3	80.8	53.3	12.8
1937	9.0	20.4	77	5.5	2.2	80.6	(1)	.9	3.6	8.6	(1)	(1)	.9	79.2	74.3	15.3	39.6	115.2	100.4	63.6	20.7	70.2	53.1	14.8
1936	8.0	20.3	74	5.0	2.3	(1)	(1)	.9	1.8	15.2	(1)	.9	2.8	76.4	60.3	13.3	44.6	127.9	73.6	69.0	21.2	69.5	------	------
Idaho:																								
1938	9.2	22.2	43	3.6	2.4	1.2	.8	4.4	(1)	20.6	(1)	1.6	2.0	22.6	77.0	10.1	73.0	180.7	92.0	58.9	1.6	46.8	73.0	27.0
1937	10.7	21.0	46	3.5	1.2	5.3	2.0	2.4	.4	69.1	(1)	1.2	1.2	22.5	80.2	11.0	75.7	174.2	93.9	69.9	4.0	35.6	87.9	30.7
1936	10.9	20.2	47	3.5	1.2	2.5	15.3	1.7	.8	21.1	.4	.8	9.1	29.0	77.5	17.0	76.3	193.6	130.2	56.4	.4	28.6	------	------
Illinois:																								
1938	11.0	14.6	43	3.4	.4	5.2	2.4	1.2	1.7	6.9	.1	.4	.3	47.9	132.9	28.7	75.4	322.0	69.3	61.7	3.9	97.8	66.1	22.3
1937	11.9	13.3	50	4.5	.2	.2	3.2	2.1	2.2	30.2	.2	.3	1.8	53.6	128.4	28.4	75.7	309.3	92.8	69.2	3.1	103.7	73.0	30.0
1936	12.2	13.3	51	4.6	.5	.2	4.9	2.3	2.8	19.7	.1	.4	3.0	54.0	131.3	30.9	84.4	331.2	103.1	67.7	3.8	109.2	------	------
Indiana:																								
1938	10.9	15.6	43	4.7	.2	5.8	2.2	1.7	2.0	14.9	.4	.6	1.1	40.5	111.4	17.0	122.5	242.5	79.1	(1)	4.5	64.7	64.6	28.6
1937	12.0	13.8	56	4.1	.4	.6	4.4	4.6	1.3	54.9	.3	.5	2.3	49.2	104.8	16.1	123.9	264.3	124.1	(1)	4.8	68.6	77.0	34.6
1936	12.4	13.8	55	5.4	.8	.2	4.5	1.7	3.7	42.8	.1	.7	2.7	49.9	108.7	18.1	135.9	281.6	132.1	(1)	3.7	83.8	82.7	29.4
Iowa:																								
1938	9.8	15.1	42	3.6	.4	1.6	2.8	3.2	.9	15.5	.5	.8	.7	20.0	127.5	21.7	104.8	249.7	73.4	55.6	2.4	61.2	57.9	14.4
1937	10.1	14.8	46	5.2	.4	.1	5.8	2.2	.2	56.3	.3	.9	1.1	21.2	119.1	21.6	105.9	225.8	84.1	51.5	2.9	62.7	71.4	13.4
1936	10.5	16.5	44	4.6	1.1	.2	4.6	1.6	1.1	26.6	(1)	.3	2.7	23.9	125.5	27.4	110.6	251.5	91.3	55.5	2.8	66.2	------	------
Kansas:																								
1938	10.2	14.8	47	4.7	0.4	2.3	1.7	3.8	0.5	19.7	(1)	0.8	0.4	24.5	116.2	24.9	93.1	238.5	63.5	58.5	2.8	100.3	99.0	23.8
1937	11.1	14.1	48	4.7	(1)	.1	6.3	1.7	1.5	58.0	.3	1.2	1.7	28.6	114.8	24.6	103.6	251.7	86.1	59.7	3.6	92.2	107.1	21.7
1936	12.4	14.8	56	6.9	1.2	.2	6.6	1.4	2.6	75.7	.3	1.2	1.8	32.9	112.3	23.2	113.4	259.3	119.0	67.0	4.0	107.2	------	------
Kentucky:																								
1938	9.2	21.5	49	4.3	1.6	6.8	1.2	7.7	2.4	29.5	1.1	.2	2.6	69.8	64.8	12.3	95.5	178.0	80.4	60.3	17.5	66.4	50.8	17.5
1937	10.6	19.3	49	4.3	2.5	3.9	1.6	5.9	3.8	81.1	.6	.6	3.7	67.8	65.1	11.5	86.8	176.8	116.1	54.4	9.0	64.6	68.1	22.6
Louisiana:																								
1938	11.4	20.0	69	7.4	5.6	.6	.4	4.5	2.1	33.4	.5	.6	.8	70.8	87.2	17.5	68.1	216.0	100.6	72.6	16.4	104.1	67.1	18.4
1937	12.3	18.7	77	8.6	4.4	1.5	.7	8.2	3.5	89.2	.1	.4	1.9	75.0	77.0	18.1	70.4	213.4	129.1	73.0	15.9	109.0	66.2	19.2
1936	12.7	17.1	87	11.2	4.5	3.8	.3	5.8	3.7	77.8	.4	.2	2.4	74.7	77.9	18.0	74.8	215.3	150.9	76.5	17.8	111.6	------	------
Maine:																								
1938	12.3	17.5	51	4.8	1.6	2.8	(1)	2.6	1.4	22.8	.7	.2	(1)	29.6	142.4	28.9	113.3	335.4	95.2	56.4	5.4	85.1	55.7	13.4
1937	14.2	18.8	60	5.2	.9	.2	.7	1.9	.5	65.7	.5	.2	.9	34.6	145.6	23.8	125.3	395.1	120.7	57.9	5.4	95.9	60.1	13.4
Maryland:																								
1938	12.7	17.0	56	3.8	.8	.7	1.0	4.6	.8	10.5	(1)	1.4	1.0	81.5	134.1	30.0	101.4	310.2	102.5	55.0	5.9	137.4	65.9	19.9
1937	14.0	16.1	65	3.8	.6	4.2	1.1	6.1	1.8	27.4	.4	1.9	3.7	83.5	131.6	27.1	117.6	332.1	144.0	62.7	7.4	152.3	80.6	29.1
1936	13.9	16.2	63	4.8	1.0	2.4	1.0	4.0	1.8	15.4	(1)	1.0	11.8	82.7	129.3	29.8	119.2	326.3	143.5	58.0	4.2	155.4	------	------
Michigan:																								
1938	10.6	19.1	45	3.5	.6	3.7	2.6	1.9	.8	8.1	.1	.3	.5	40.7	116.7	27.7	90.8	297.3	69.9	58.2	4.3	58.4	62.8	22.3
1937	11.8	18.0	54	3.8	.4	.2	4.5	2.7	1.0	31.4	(1)	.3	1.1	46.9	115.5	27.0	91.1	291.2	112.7	64.2	3.9	65.2	80.1	33.4
1936	11.8	18.1	54	5.2	.6	.3	3.1	2.4	.7	17.7	.3	.6	1.6	43.9	113.4	27.7	98.7	297.0	115.2	70.6	6.3	70.1	------	------

[1] Data not compiled for these causes prior to 1937.
[2] Data not available.
[3] No deaths reported.
[4] January to March.

Provisional mortality rates from certain causes in the first 6 months of 1938, with comparative provisional data for the corresponding period in preceding years—Continued

State and period	All causes, rate per 1,000 population (annual basis)	Births (exclusive of stillbirths) per 1,000 population (annual basis)	Rate per 1,000 live births		Death rate per 100,000 population (annual basis)																				
			Total infant mortality	Maternal mortality	Typhoid fever (1, 2)	Measels (7)	Scarlet fever (8)	Whooping cough (9)	Diptheria (10)	Influenza (11)	Acute poliomyelitis and polioencephalitis (16)	Encephalitis, epidemic or lethargic (17)	Epidemic cerebrospinal meningitis (18)	Tuberculosis, all forms (23-32)	Cancer, all forms (45-53)	Diabetes (59)	Cerebral hemorrhage, apoplexy (82a, b)	Diseases of the heart (90-95)	Pneumonia, all forms (107-109)	Diseases of the digestive system (115-129)	Diarrhea and enteritis, under 2 years (119)	Nephritis (130-133)	All accidents (176-195, 201-214) [1]	Automobile accidents (206, 203, 210) [1]
JANUARY-JUNE—continued																								
Minnesota:																								
1938	9.8	17.6	40	3.5	0.2	0.7	1.7	2.7	0.3	10.5	0.2	0.4	0.4	30.4	140.0	26.1	88.2	250.4	76.9	52.1	1.9	44.9	62.4	19.4
1937	10.7	18.4	43	3.4	.3	.2	2.4	2.1	.4	43.2	(8)	.9	1.5	37.0	141.2	24.7	91.6	241.4	98.2	55.3	2.1	48.4	65.9	17.1
1936	10.8	16.9	45	4.7	.5	1.6	7.4	1.0	.3	18.1	.2	.6	2.6	37.7	129.0	27.3	84.7	250.9	100.7	60.7	4.0	49.8	-----	-----
Missouri:																								
1938	11.6	15.4	52	3.7	1.4	9.2	3.1	5.3	3.0	23.6	.6	.6	.6	51.8	125.3	24.0	91.2	276.7	114.5	57.4	6.4	107.5	67.6	22.4
1937	12.9	13.1	68	6.5	2.7	.1	4.1	3.0	2.4	63.2	.4	.8	1.8	60.6	122.9	25.1	99.8	282.5	165.9	58.3	5.2	109.8	80.3	27.3
Montana:																								
1938	10.7	19.2	41	3.8	.7	1.5	3.0	4.8	1.8	27.4	(8)	.4	1.5	50.0	99.5	19.2	89.2	222.7	98.0	66.6	3.0	36.6	101.4	20.4
1937	12.6	19.2	57	4.3	2.6	.4	3.7	1.1	2.2	102.2	(8)	.7	2.2	43.4	106.2	19.8	96.9	227.1	142.9	67.7	1.1	70.3	91.3	20.2
1936	12.1	19.2	51	5.3	1.1	.4	12.1	4.2	3.0	29.9	(8)	(8)	4.2	44.7	100.0	24.2	91.3	198.4	149.2	81.8	6.4	76.5	-----	-----
Nebraska: [10]																								
1938	9.2	15.7	41	2.9	.5	.9	1.6	3.0	1.4	16.6	.2	.7	.5	17.9	124.0	24.8	89.3	230.9	72.6	49.6	2.6	62.0	48.2	14.5
1937	10.8	15.7	53	5.5	.5	.5	5.5	2.5	1.2	89.7	.5	.4	1.9	24.1	108.6	28.9	92.0	239.9	94.8	60.4	2.6	70.0	52.1	17.7
1936	10.9	16.3	46	7.4	.7	1.4	9.9	1.8	1.9	30.9	.4	.7	2.1	19.9	110.7	29.5	96.9	251.7	99.0	84.0	3.4	79.6	-----	-----
Nevada:																								
1938	11.9	17.0	43	3.5	2.0	(8)	(8)	2.0	5.9	2.0	(8)	(8)	(8)	67.2	100.8	15.8	83.0	276.7	128.5	57.3	(8)	37.6	102.8	37.6
1937	13.2	13.6	60	10.3	(8)	(8)	4.0	4.0	(8)	16.0	(8)	(8)	(8)	71.9	73.9	10.0	83.8	257.6	173.7	37.9	4.0	45.9	135.8	39.9
New Jersey:																								
1938	10.4	12.6	42	3.5	.2	1.4	.4	1.1	.9	6.4	.1	.8	.7	46.7	126.0	30.5	81.4	335.7	72.8	57.1	3.0	76.0	54.1	18.2
1937	10.8	12.3	44	3.7	.5	2.2	.6	1.4	.7	16.8	.1	.7	1.7	50.5	122.2	32.8	79.6	331.7	92.1	57.4	2.6	74.0	74.0	24.1
1936	10.7	12.2	49	4.1	.5	.4	1.0	1.3	.5	11.3	.3	.8	2.4	51.6	122.5	32.3	85.0	315.7	88.7	56.0	3.3	82.4	-----	-----
New Mexico:																								
1938	13.3	34.2	88	5.2	2.4	22.4	1.4	21.6	3.8	20.5	1.0	(8)	1.0	92.7	64.5	7.2	51.1	146.7	113.2	84.1	22.0	70.2	86.5	31.5
New York:																								
1938	12.0	14.4	44	3.9	0.3	1.2	0.7	1.2	0.4	4.9	(11)	0.8	1.0	53.9	155.9	38.2	68.3	382.4	81.6	63.3	5.3	78.2	60.4	16.4
1937	12.8	14.5	49	4.1	.3	.6	1.2	1.2	.9	17.1	(11)	.7	1.5	62.2	150.6	40.1	79.6	389.7	119.9	70.5	6.1	82.8	68.0	19.8
1936	12.7	14.0	50	5.6	.6	1.8	2.3	1.0	.4	9.5	(8)	.7	3.0	61.5	146.2	38.1	85.0	375.9	117.9	69.9	5.2	84.9	-----	-----

North Carolina:																							
1938	10.0	22.7	69	6.4	1.3	11.8	.7	7.7	3.6	19.2	.3	.6	1.1	56.1	54.0	10.9	84.0	167.4	95.2	73.2	27.2	93.3	59.3	21.3
1937	10.2	23.1	65	6.0	1.4	1.3	.4	3.6	3.0	42.6	.3	.6	1.4	60.8	52.6	11.0	82.1	165.6	107.8	60.3	16.4	90.0	67.7	24.9
1936	11.0	22.6	65	6.7	1.0	.2	.7	.9	3.0	53.2	.4	.6	1.9	62.0	52.5	12.6	(7)	(7)	142.8	(7)	9.8	(7)	------	------
North Dakota:																							
1938	7.1	18.5	45	1.7	(7)	2.8	3.4	8.5	.8	11.1	(7)	.6	1.4	23.9	83.2	19.9	56.4	142.7	58.4	47.3	5.1	42.2	39.9	10.5
1937	8.6	18.8	55	5.3	(8)	(8)	1.7	.3	1.1	47.4	(8)	.3	2.9	26.8	78.5	19.1	77.7	172.5	87.7	53.7	9.7	37.4	50.6	11.7
Ohio:																							
1938	11.4	16.2	46	3.6	.4	5.0	1.7	2.0	1.2	14.7	.2	.3	.9	49.0	127.8	27.9	107.0	289.4	77.1	59.5	3.4	81.4	79.0	23.6
1937	12.6	14.9	53	5.8	.8	1.8	2.4	3.8	1.4	49.3	.2	1.0	2.2	54.8	113.5	28.5	115.9	299.6	111.4	63.3	4.4	85.0	92.6	36.4
1936	12.5	14.6	52	5.4	1.0	1.1	3.0	2.1	1.4	27.8	.2	1.1	3.2	55.9	126.6	30.0	122.4	298.6	111.4	67.7	4.0	93.7	85.9	20.2
Oklahoma:																							
1938	8.4	17.5	47	4.7	2.3	3.2	.9	10.7	4.2	22.8	1.2	.5	1.3	48.8	71.7	13.3	67.8	134.7	71.3	53.5	6.4	61.0	68.3	20.8
1937	9.2	14.2	66	6.4	2.2	1.7	1.7	1.7	2.0	71.0	1.1	.2	3.4	56.0	73.9	13.3	62.2	141.2	103.7	55.7	4.0	68.9	60.5	22.9
Oregon:																							
1938	11.8	15.8	38	3.4	.2	.6	1.4	2.5	1.4	12.7	.6	2.3	1.6	29.4	139.9	23.2	107.0	283.3	70.9	48.5	2.1	120.8	82.6	24.9
1937	13.2	15.1	46	4.3	.6	.2	1.4	2.4	.2	54.6	.6	1.0	.8	38.1	122.3	24.0	111.9	302.8	89.7	57.1	.6	115.6	88.6	29.1
Pennsylvania:																							
1938	11.0	16.1	50	3.7	.6	4.4	1.7	1.8	1.1	13.5	.1	.7	.8	42.7	116.8	32.6	83.9	119.1	75.4	53.9	4.2	84.6	54.8	14.6
1937	12.1	15.6	55	4.7	.6	1.0	2.2	2.8	1.1	44.9	.1	.8	1.9	49.9	115.5	33.4	82.9	324.2	102.1	54.4	4.2	92.3	61.1	20.0
1936	11.8	15.7	52	4.7	.5	.5	2.2	1.2	1.5	20.8	.1	.5	1.8	46.6	111.5	31.0	92.2	316.8	103.0	54.7	5.5	90.4	------	------
Rhode Island: [10]																							
1938	12.7	15.2	42	2.3	.4	(7)	.7	2.5	.4	7.1	(7)	.7	1.4	46.5	157.6	44.4	106.1	379.8	129.2	59.3	2.8	122.8	54.3	11.4
1937	13.9	15.0	56	4.2	.4	(7)	2.1	2.5	.4	24.5	(7)	.7	4.2	55.0	162.6	45.8	109.0	412.4	146.9	56.8	3.9	126.7	46.9	13.1
1936	12.8	15.0	50	4.5	(7)	.7	3.2	1.1	.4	17.7	(7)	.7	5.0	51.3	135.8	35.0	110.7	372.3	137.1	61.2	3.9	111.4	------	------
South Carolina:																							
1938	10.6	19.0	92	9.0	3.1	12.9	.6	15.4	1.3	42.6	.5	.5	.7	48.6	80.1	11.0	90.7	185.4	100.2	41.3	10.7	83.4	52.0	21.1
1937	10.6	18.4	91	8.4	4.3	1.0	.4	3.0	2.5	65.3	.6	.3	1.1	47.3	48.5	11.2	89.7	178.5	109.4	24.0	6.9	85.9	63.7	24.7
1936	10.8	18.7	85	8.9	3.2	.6	.5	3.6	2.2	76.6	.9	.2	4.1	51.9	43.0	10.0	94.6	178.8	137.2	26.2	4.1	88.0	------	------
South Dakota:																							
1938	7.2	16.3	51	3.2	1.4	.3	1.4	16.6	.6	13.1	(7)	(7)	.3	35.0	90.6	17.5	64.7	169.0	65.8	50.4	3.5	39.9	50.4	11.9
1937	9.7	16.7	57	5.6	.3	(8)	4.7	1.2	.6	70.8	(8)	.9	1.7	36.1	79.6	21.8	73.7	179.5	72.1	46.3	2.6	47.2	51.6	13.1
1936	9.3	19.0	49	4.8	1.4	.3	6.1	.9	1.2	28.8	(8)	.3	(8)	34.9	86.9	24.7	83.4	166.2	87.8	52.9	7.3	68.3	------	------
Tennessee:																							
1938	9.6	15.9	66	6.3	1.6	12.1	.4	8.0	2.3	32.7	.6	.4	1.6	75.9	67.5	10.0	79.4	189.9	92.9	68.2	17.7	60.0	54.6	16.3
1937	10.6	15.5	67	8.3	2.1	1.1	.8	3.9	3.3	76.5	.5	.6	3.3	86.8	65.4	11.3	79.4	160.2	120.2	62.7	10.3	65.4	63.6	21.4
1936	11.6	15.9	68	7.4	1.8	1.2	1.1	2.6	2.9	87.3	.3	1.0	5.4	91.6	61.3	13.5	81.5	167.5	159.3	62.4	7.5	67.8	------	------
Utah:																							
1938	9.3	25.3	44	4.3	(7)	3.9	1.9	5.4	1.9	13.2	(7)	.4	2.7	23.3	87.6	20.5	51.2	242.4	73.3	60.1	1.9	52.0	88.8	33.4
1937	10.1	23.5	42	3.6	.8	1.2	2.0	3.1	1.2	38.5	.4	1.2	2.0	23.7	90.5	23.7	62.2	251.0	75.4	71.5	2.3	57.9	76.5	29.1
Vermont:																							
1938	11.0	14.7	52	3.5	(7)	6.3	.5	3.7	6.3	18.3	.5	.5	(7)	41.3	122.8	26.6	112.3	306.7	103.4	56.9	2.1	83.6	48.1	14.6
1937	12.0	13.1	57	12.0	1.0	(8)	(8)	1.0	1.0	53.7	(8)	(8)	.5	46.9	135.8	22.6	104.2	321.7	126.4	53.2	3.7	74.8	59.5	15.8
Virginia:																							
1938	10.7	18.4	68	5.4	1.2	6.0	.2	8.0	2.6	23.9	.3	.1	2.1	67.7	75.1	16.2	93.8	230.5	85.8	49.4	9.8	82.4	63.2	21.5
1937	11.4	18.2	69	5.4	1.0	3.7	.4	7.8	2.0	65.5	.6	.7	6.2	65.8	71.8	16.9	92.3	233.0	132.4	43.9	7.2	86.4	61.5	22.6
1936	12.1	19.1	64	5.5	1.5	1.4	.6	3.8	3.0	58.3	.3	.4	7.5	70.2	70.8	17.4	101.6	244.2	123.2	46.8	3.7	98.9	------	------

[1] Data not compiled for these causes prior to 1937.
[7] Data not available.
[8] No deaths reported.
[10] January to May.
[11] Less than 0.1 of 1 per 100,000 population.

Provisional mortality rates from certain causes in the first 6 months of 1938, with comparative provisional data for the corresponding period in preceding years—Continued

State and period	All causes, rate per 1,000 population (annual basis)	Births (exclusive of stillbirths) per 1,000 population (annual basis)	Rate per 1,000 live births		Death rate per 100,000 population (annual basis)																				
			Total infant mortality	Maternal mortality	Typhoid fever (1, 2)	Measles (7)	Scarlet fever (8)	Whooping cough (9)	Diphtheria (10)	Influenza (11)	Acute poliomyelitis and polioencephalitis (16)	Encephalitis, epidemic or lethargic (17)	Epidemic cerebrospinal meningitis (18)	Tuberculosis, all forms (23–32)	Cancer, all forms (45–53)	Diabetes (59)	Cerebral hemorrhage, apoplexy (82a, b)	Disease of the heart (90–93)	Pneumonia, all forms (107–109)	Diseases of the digestive system (115–129)	Diarrhea and enteritis, under 2 years (119)	Nephritis (130–132)	All accidents (176–195, 201–214) [1]	Automobile accidents (206, 208, 210) [1]
JANUARY–JUNE—continued																									
Washington:																									
1938	11.3	15.1	39	3.8	0.6	0.2	0.5	2.9	0.8	15.3	0.1	1.8	0.7	45.6	135.2	24.5	112.9	286.5	81.6	58.2	0.6	71.6	81.1	23.8
1937	12.0	14.0	44	5.1	.7	1.3	1.6	.8	1.1	42.2	.1	2.4	1.3	46.0	129.3	23.5	107.9	304.8	88.5	54.7	1.2	79.8	87.3	26.6
1936	12.2	13.8	46	4.6	.4	3.7	2.4	.9	.2	39.3	.6	2.3	1.8	52.4	128.8	26.2	110.2	291.3	90.6	66.0	1.2	80.8	91.4	31.7
West Virginia:																									
1938	9.4	20.1	64	3.9	2.0	11.4	1.8	10.0	2.7	26.1	1.1	.7	2.8	49.8	69.1	16.3	73.3	165.0	86.6	49.8	7.6	71.6	69.1	16.5
1937	10.6	20.2	64	6.4	1.6	1.5	2.1	10.3	3.1	69.4	.8	.1	6.9	56.0	66.9	15.7	73.0	174.3	122.8	54.9	7.9	66.0	93.4	20.1
1936	10.8	19.1	64	7.2	1.8	2.2	1.8	3.5	5.2	45.0	.8	.5	7.0	56.7	67.4	15.2	81.4	185.6	127.6	52.7	4.5	73.1	------	------
Wisconsin:																									
1938	10.6	17.9	44	2.9	.3	1.9	1.4	1.8	.4	7.7	.3	.3	.2	31.7	134.9	31.3	94.3	238.0	68.8	(2)	3.0	67.3	62.3	16.9
1937	11.9	17.3	49	3.9	.3	.1	3.5	1.0	.6	74.7	(2)	.1	1.0	36.9	130.7	28.2	97.3	310.3	90.3	(2)	4.2	74.8	75.0	24.2
1936	11.5	17.1	51	4.5	.5	.5	6.8	1.9	.4	19.5	------	.6	1.5	37.0	133.9	26.8	103.8	297.6	90.6	(2)	4.6	73.1	------	------
Wyoming:																									
1938	9.5	18.7	58	4.5	(2)	(2)	.8	22.1	1.7	20.4	(2)	.8	1.7	19.6	92.7	12.8	69.8	240.2	87.6	71.5	7.6	50.2	102.1	32.3
1937	11.5	18.3	54	5.1	.9	.9	6.9	3.4	(2)	81.5	.9	1.7	3.4	15.4	73.8	8.6	84.1	270.3	149.3	77.2	11.2	35.2	105.5	40.3

[1] Data not compiled for these causes prior to 1937.
[2] Data not available.
[3] No deaths reported.

EFFECT OF SODIUM SELENITE AND SELENATE ON THE OXYGEN CONSUMPTION OF MAMMALIAN TISSUES

By C. I. WRIGHT, *Pharmacologist, United States Public Health Service, Division of Pharmacology, National Institute of Health*

That selenium is highly toxic has been known for some time (*1*), but renewed interest in its toxicology has developed with the demonstration (*2*) of a relationship between the selenium content of forage and the cattle poisoning known as "alkali disease." Consequently, there have appeared a number of reports (*2*, *3*) of extensive pathological changes in animals following the feeding and injection of selenium, but the fundamental cause of the injuries developed is still obscure.

There is evidence that selenium interferes with respiratory metabolism. Collett (*4*) showed that selenite inhibited succinic dehydrogenase of minced muscle. More recently Labes and Krebs (*5*) have shown that the oxygen consumption of a muscle powder suspension is inhibited by selenite; and Potter and Elvehjem (*6*), using sugars as substrate, have found that selenite inhibits the oxygen consumption of yeast, but has little effect on the oxidation of lactic or pyruvic acids.

There has been no systematic study of the effects of selenium on the metabolism of different tissues; and, with the exception of yeast cells, the interference with oxidations has been noted on tissue "brei" or extracts. In all cases relatively high concentrations of selenium were used. In order to assume that the toxic effects of selenium are a result of interference with oxidations it seems essential to demonstrate that such interference is possible in intact cells and at concentrations within the range of those existing in the poisoned animal. Therefore, freshly sliced organs were used in determining the sensitivity of different tissues to selenite and selenate. The inhibiting action of these selenium salts was also determined in the presence of several substrates, and attempts were made to counteract the depression of oxygen consumption.

METHOD

Measurements of oxygen consumption were made with the Barcroft differential type manometers fitted with two side-arm flasks of approximately 20 cc capacity. The carbon dioxide was absorbed by 0.2 cc of 7 percent KOH in central wells containing rolled filter paper. After introduction of the tissue slices the manometer flasks were immersed in a water bath at 37.5° C., flushed with water-saturated oxygen, and shaken at a rate of 110 oscillations per minute. The suspending medium was a phosphate buffered (pH 7.3) physiological salt solution containing 0.2 percent glucose as described by Dickens and Greville (*7*). The total volume of fluid in each flask was 3.0 cc.

With the exception of muscle and tumor the tissues were taken from 3- to 5-month old male and female white rats (Wistar strain) weighing

on the average 151 (males) and 135 (females) grams. The rats were fed an adequate semisynthetic diet the ingredients of which have been given in an earlier publication (*3*). Mouse diaphragm was used for determinations on muscle, and tumor slices were obtained from rats [1] given an intramuscular inoculation of Walker 256 mammary carcinoma 2 weeks previously. The nonnecrotic portions of the tumor mass were chosen for slicing.

The animals were decapitated and the organs quickly removed and sliced with a straight razor to a thickness less than 0.4 mm. Approximately 30 minutes elapsed between the time the animal was killed and the first reading of the manometers. Readings were made at 15-minute intervals. At the completion of the experiment the slices were dried for 17 hours in an oven at 100° C. and the oxygen consumption calculated per mg of dry weight.

The solutions to be tested were placed in side arms at 10 times final concentration and tipped into the main compartment containing the tissue after a control period. All concentrations given are the final dilutions after tipping. The dl-lactic, pyruvic, and citric acids were carefully neutralized and diluted with physiological salt solution. Determinations were repeated on different rats at least once and usually several times, and so each curve given represents a number of experiments.

RESULTS

Sodium selenite.—The effect of sodium selenite on the oxygen consumption of five different tissues is shown in figure 1. The rate of oxygen consumption in mm^3 per mg per hour is plotted against the time in minutes. The selenite was tipped from the side arm after a control period of 45 minutes, as indicated by the arrows on the time axis. Under the same conditions untreated tissues maintain 85 to 90 percent of the initial rate of oxygen consumption for 5 hours.

The effect of sodium selenite common to all the tissues studied is a depression of the rate of oxygen consumption. If the selenite is in sufficient concentration, the consumption of oxygen eventually falls to a value representing 5 percent or less of the initial rate in all tissues tested except tumor tissue. The oxygen consumption of the Walker tumor was reduced only 70 percent at concentrations as high as M/1,000, representing more than 100 times the minimal effective concentrations.

There are other distinct differences in the action of selenite on different tissues, the most striking of which is a marked increase in the rate of oxygen consumption of liver slices cut from livers of well-nourished rats. This increase is sharp and of short duration at the higher concentrations (M/1,000) but less intense and prolonged as the

[1] I am indebted to Dr. W. R. Earle of this laboratory for the tumor-bearing animals.

concentration is decreased. The excess consumption of oxygen is variable at a single concentration and apparently depends on the nutritional condition of the animal. If food is withheld from the rat for a period of 24 to 48 hours immediately preceding the removal of the liver, the increase in oxygen consumption no longer occurs on addition of selenite to the suspending medium. Such periods of fasting reduce the glycogen content of the rat liver to 0.1 percent (*8*). Tumor and muscle frequently show a slight increase in the rate of oxidation following the addition of selenite but never as marked as liver.

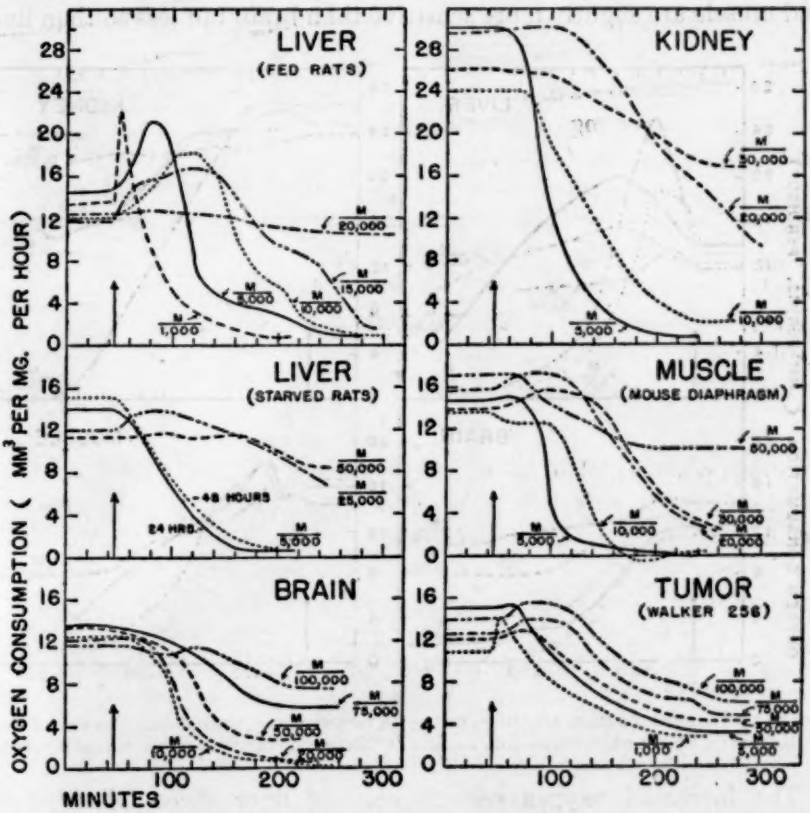

FIGURE 1.—The effect of sodium selenite on the oxygen consumption of tissue slices. The vertical arrows indicate the time of addition of selenite. Molar concentrations are given for each curve.

The tissues also vary in their sensitivity to selenite. The minimal molar concentrations affecting oxygen consumption are approximately as follows: Liver (fed) M/20,000, liver (unfed) M/25,000, kidney M/30,000, muscle M/50,000, brain cortex M/100,000, and tumor less than M/100,000. At all concentrations there is a fairly long induction period (30–60 minutes) during which the selenite has no depressant effect on oxygen consumption.

Sodium selenate.—The main difference between the action of sodium selenite and sodium selenate (fig. 2) is in the concentration required for equivalent depression of oxygen consumption. Selenate causes an initial increase in oxidation when added to liver slices from well nourished rats and the increase disappears when food is withheld. At sufficiently high concentrations selenate also practically abolishes oxygen consumption. The order of sensitivity of the different tissues is not the same for selenate as for selenite. Thus, brain slices are but little affected by M/5,000 selenate, while the oxygen consumption of liver slices is definitely altered by half that concentration. Kidney and muscle are slightly more sensitive than brain but less so than liver.

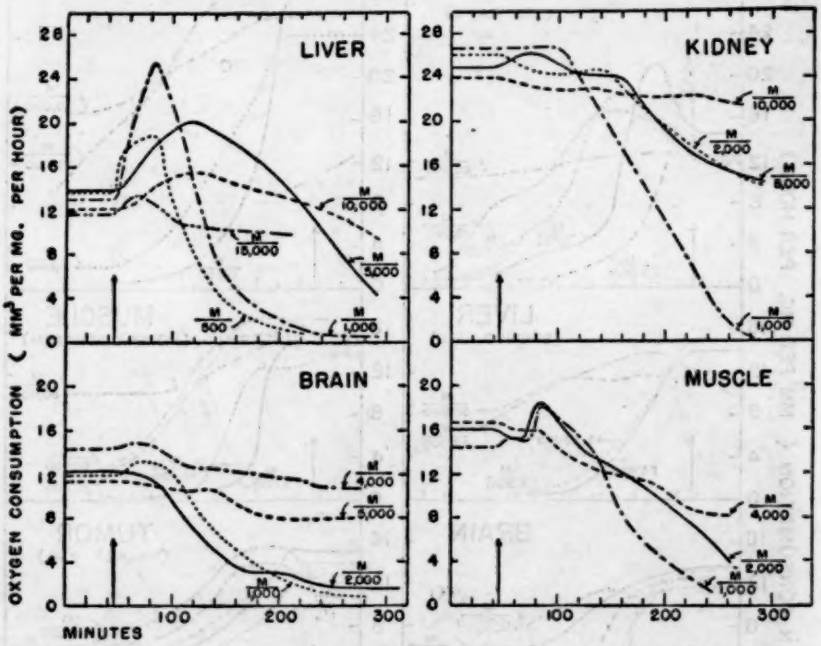

FIGURE 2.—The effect of sodium selenate on the oxygen consumption of tissue slices. The vertical arrows indicate the time at which the selenate was added. Molar concentrations are given for each curve.

The increased oxygen consumption of liver slices following the addition of selenite or selenate is probably an indirect result of an increased rate of glycolysis, resulting in a higher substrate concentration, or may be due to an interference with the normal glycolytic process and formation of more readily oxidizable substrates. This is indicated by the fact that fasting eliminates the stimulation and that iodoacetate, by inhibiting glycolysis (*9*), can greatly diminish, and, under some circumstances, completely prevent the rise in oxygen consumption.

Figure 3 (A) shows the effect of adding iodoacetate and selenite to four liver slices taken from one animal. Addition of the selenite

alone (curve 1) caused an increase in oxygen consumption to 20.6 mm^3 per mg per hour. Addition of the iodoacetate alone (curve 2) had but little effect on the oxygen consumption for a period of an hour or more. Addition of the selenite and iodoacetate together at 30 minutes (curve 3) limited the rise in oxygen consumption to a maximum of 15.5 mm^3 per mg per hour, and when the selenite was added 30 minutes after the iodoacetate (curve 4) there was practically no increase.

If selenite and selenate in some manner increase the rate of breakdown of glycogen in livers from fed rats and, through greater substrate formation, increase oxidations, it should be possible to simulate these conditions by adding substrates and selenite to fasting rat liver slices. Graph B of figure 3 shows that M/5,000 selenite alone added to starved rat liver slices caused no increase in oxygen

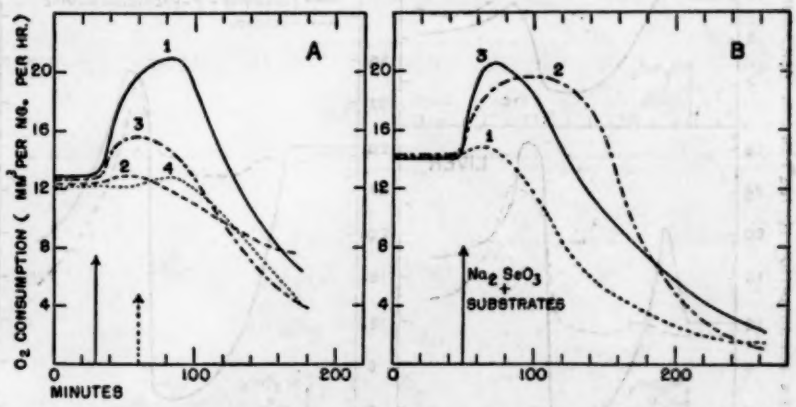

FIGURE 3.—Graph A shows the oxygen consumption of liver slices from a well-nourished rat after addition of Na_2SeO_3 (M/5,000) and iodoacetate (M/10,000). 1=selenite alone; 2=iodoacetate alone; 3=selenite and iodoacetate together at 30 minutes; 4=iodoacetate at 30 minutes followed by selenite at 60 minutes. Graph B shows the effect of selenite (M/5,000) and selenite plus substrates added to liver slices from a 24-hour fasted rat. 1=selenite; 2=selenite and pyruvate (0.02M); 3=selenite and succinate (0.02M).

consumption (curve 1). If pyruvate or succinate is added with the selenite (curves 2 and 3), the resulting rate of oxygen consumption is quite comparable to the curve resulting from the addition of selenite alone to liver slices from a fed rat (fig. 1). Furthermore, when the addition of pyruvate alone has raised the oxygen consumption of liver slices from unfed rats the subsequent addition of selenite does not further increase the oxidative rate. The latter fact is another indication that the stimulating action of selenite or selenate is effected through increased glycolysis rather than catalysis of oxidation.

However, it should be mentioned that up to the present time it has not been possible to demonstrate any effect of selenite on anaerobic glycolysis (glucose substrate) of liver, brain, kidney, or tumor slices. Mammalian tissues appear to differ from yeast in this respect (*10*).

Substituting glycogen for glucose in the Ringer solution did not result in increased oxygen consumption on addition of selenite to starved liver slices. The glycogen probably failed to penetrate into the tissue cells.

THE OXIDATION OF p-PHENYLENEDIAMINE AND SUBSTRATES

Collett (*4*) showed that selenite inhibits the succinic dehydrogenase of minced tissue, and this finding has been confirmed repeatedly (*5, 11, 12*). Labes and Krebs (*5*) found that a suspension of muscle powder poisoned with selenite was able to catalyze the oxidation of p-phenylenediamine. The latter finding indicates that the cyto-

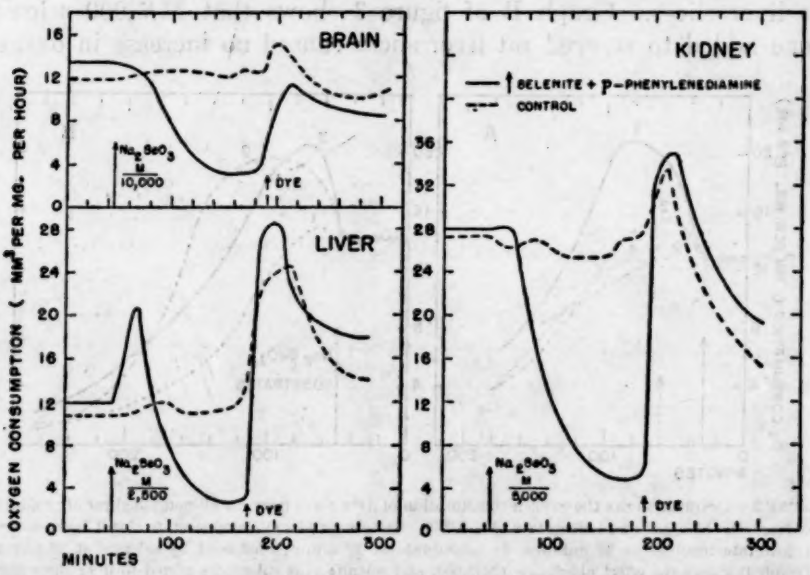

FIGURE 4.—The oxidation of p-phenylenediamine by tissue slices poisoned with sodium selenite. The selenite was added at 45 minutes and the p-phenylenediamine (0.02M) about two and a half hours later as indicated by small arrows.

chrome-indophenol-oxidase system (*13*) is intact and that the effect of selenite might be limited to succinic dehydrogenase.

Figure 4 shows that brain, liver, and kidney slices are able rapidly to oxidize p-phenylenediamine after being heavily poisoned with selenite. The solid lines represent the oxygen consumption of tissues treated with selenite and p-phenylenediamine, and the broken lines the tissues treated with p-phenylenediamine only. The selenite was added after 45 minutes, and approximately 2 hours later freshly prepared and neutralized p-phenylenediamine hydrochloride was added to the side arms and subsequently tipped on the tissues. The oxygen consumption of selenized tissues rose to the level of the non-poisoned tissues, showing that the cytochrome oxidase system had not been impaired.

If the oxidative mechanism consists of dehydrogenase, cytochrome, and oxidase (*13*), and selenite does not destroy the cytochrome nor the oxidase, then the action must be on the enzymes that activate the substrate hydrogen. The work of Potter and Elvehjem (*6*) on selenite poisoning in yeast shows that the oxidation of some substrates is not affected by selenite. There is some indication, then,

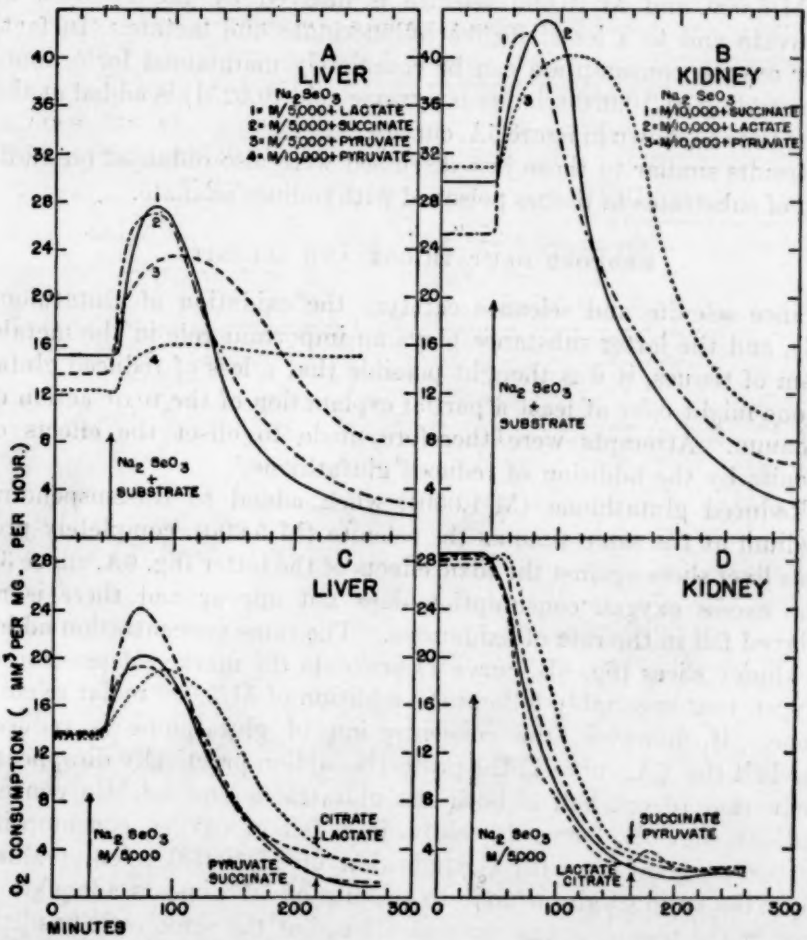

FIGURE 5.—The effect of addition of substrates to tissues poisoned with sodium selenite. Graphs A and B show the addition of selenite and substrates at the same time (45 min.). Graphs C and D show the inability of substrates to restore oxidation after poisoning with sodium selenite. The selenite was added at 30 minutes and the substrates (0.02M) at 220 minutes (liver) and 165 minutes (kidney).

that selenite is not a general dehydrogenase poison. In order to test this effect for mammalian tissues a number of substrates were added to the tissues after poisoning with sodium selenite (fig. 5, C and D). The selenite was added after 30 minutes and the substrate tipped from a second side arm after 160 minutes (kidney) and 220 minutes (liver). Neither lactate, pyruvate, citrate, nor succinate at con-

centrations of 0.02 molar caused any increase in oxygen consumption. It seems likely that selenite is a general poison for dehydrogenating enzymes.

However, substrates added at the same time as the selenite afford some protection to the tissue against the poisonous action of the latter. Thus in figure 5 (A and B) the fall in oxygen consumption due to M/5,000 and M/10,000 selenite is delayed by the addition of pyruvate and to a lesser degree by succinate and lactate. In fact, liver oxygen consumption can be completely maintained for 5 hours after adding M/10,000 selenite if pyruvic acid (0.02M) is added at the same time as shown in figure 5A, curve 4.

Results similar to those just discussed were also obtained on addition of substrates to tissues poisoned with sodium selenate.

REDUCED GLUTATHIONE AND SELENITE

Since selenite and selenate catalyze the oxidation of glutathione (*14*), and the latter substance plays an important role in the metabolism of tissues, it was thought possible that a loss of reduced glutathione might offer at least a partial explanation of the toxic action of selenium. Attempts were therefore made to offset the effects of selenite by the addition of reduced glutathione.[2]

Reduced glutathione (M/1,000), when added to the suspending medium at the same time as the selenite (M/5,000), completely protects liver slices against the toxic effects of the latter (fig. 6A, curve 3). The excess oxygen consumption does not appear and there is no delayed fall in the rate of oxidations. The same concentration added to kidney slices (fig. 6B, curve 1) prevents the marked depression of oxygen that invariably follows the addition of M/5,000 molar selenite alone. If, however, the concentration of glutathione is reduced one-half (fig. 6A, curve 1) the protective action practically disappears. Reduction to one-half of both the glutathione and selenite concentrations (fig. 6B, curve 2) results in a fall of oxygen consumption almost as great as with the addition of M/10,000 selenite alone. Thus the ratio of glutathione to selenite of 5:1 appears adequate to protect the tissues at one concentration, but the same ratio has little protective action at a lower concentration level.

Reduced glutathione also offers partial protection to brain slices against M/20,000 selenite (fig. 6C).

The addition of glutathione to the tissues 30 to 60 minutes after the selenite will decrease somewhat the rate of fall of oxygen consumption (fig. 6A, curve 2, and 6B, curve 3). However, it is not possible to restore oxidation once lost through the action of selenite.

[2] The glutathione was made available through the courtesy of Dr. J. M. Johnson who prepared it in this laboratory.

This is shown by graphs D and E of figure 6. The selenite was added to the kidney slice after 45 minutes; 150 minutes later 0.02 M reduced glutathione was added. The oxygen consumption temporarily increased to a value above the normal rate but fell sharply to a level below that preceding the glutathione addition. The same

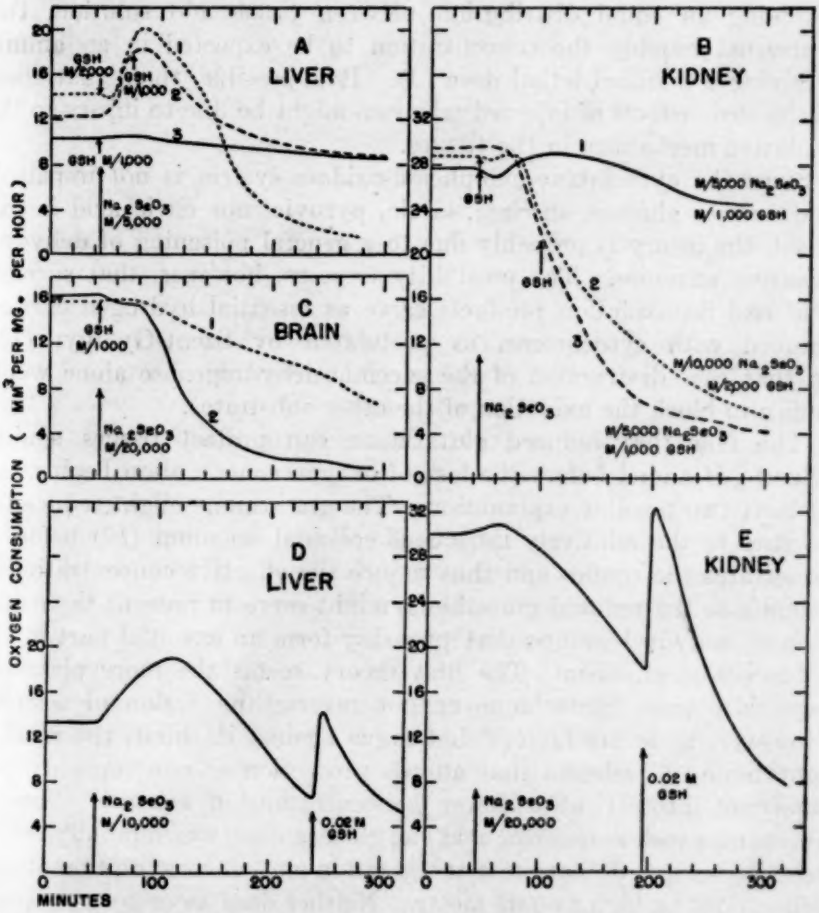

FIGURE 6.—The effect of reduced glutathione (GSH) on selenite-poisoned tissues. In A, B, and C the selenite was added at 45 minutes and the addition of GSH is indicated by small arrows. Molar concentrations are given for each curve. The lower graphs D and E show the effect of addition of 0.02M GSH after 50 percent reduction of O_2 consumption by selenite.

result was obtained with liver (fig. 6D). The selenite was added after 45 minutes and the glutathione after 240 minutes. The increase in oxygen consumption after the glutathione addition was not maintained and in all probability represents the oxidation of a portion of the added glutathione.

DISCUSSION

Mammalian tissues suffer an apparently irreversible loss of ability to oxidize naturally occurring substrates after contact with sodium selenite or selenate. The inhibition of oxygen consumption can be demonstrated in some tissues at a concentration of 10^{-5} molar and, assuming an equal distribution between tissue and solution, this represents roughly the concentration to be expected in an animal receiving a minimal lethal dose (*3*). It is possible, then, that some of the toxic effects of injected selenium might be due to injury to the oxidative mechanism in the tissues.

Since the cytochrome-indophenol-oxidase system is not impaired, and neither glucose, succinic, lactic, pyruvic, nor citric acid is oxidized, the injury is probably due to a general poisoning of dehydrogenating enzymes. The possibility remains, however, that succinic acid and its oxidation products serve as essential hydrogen carriers coupled with cytochrome, as postulated by Szent-Györgyi (*15*). In that case destruction of the succinic dehydrogenase alone would suffice to block the oxidation of the other substrates.

The fact that reduced glutathione can protect tissues against selenite, if added before the loss of oxygen consumption begins, has at least two possible explanations: The glutathione might reduce the selenite to the relatively innocuous colloidal selenium (*16*) before it penetrates the tissues and thus reduce the effective concentration of selenite or the reduced glutathione might serve to prevent the oxidation of sulfydryl groups that probably form an essential part of the oxidative mechanism. The first theory seems the more plausible, especially since glutathione cannot reverse the action of selenite. However, there are factors that argue against it: First, the ratio of glutathione to selenite that affords protection at one concentration does not protect at a lower concentration of selenite. Second, substances such as ascorbic acid and glucosamine, which rapidly reduce selenite *in vitro*, do not prevent the fall in oxygen consumption at concentrations as high as 0.02 molar. Neither does ascorbic acid reduce dithio groups in tissue (*17*).

Since the studies just reported were completed, Hopkins and Morgan (*18*) have shown that succinic dehydrogenase can be inactivated by oxidized glutathione and reactivated by reduced glutathione. In the light of their findings an attempt was made to reverse the action of selenite by exposing poisoned tissues to reduced glutathione in nitrogen for 30 minutes and then remeasuring the oxygen consumption with glucose and succinic acid as substrates. The poisoned tissues did not regain their oxidative ability through this procedure.

The delayed action of the selenite and the selenate may be due to a relatively slow penetration of the tissues. Cooper et al. (*19*) found

that valonia was impermeable to selenite. On the other hand, the rise in oxygen consumption of liver slices is quite prompt and indicates that the liver at least is readily permeable to selenite and selenate. Smith and co-workers (*20*) also found the selenium content of kidneys higher than blood 5 minutes after an intravenous injection of selenite.

The possibility that the inhibition of the oxygen consumption of yeast by selenite might be an indirect result of interference with glycolysis is indicated by the results of Potter and Elvehjem (*6*). This does not seem to be true for mammalian tissues, since manometric measurements of anaerobic glycolysis of liver, kidney, brain, or tumor are not influenced by the presence of selenite. These results will be published later.

SUMMARY

1. Sodium selenite and selenate inhibit the oxygen consumption *in vitro* of liver, kidney, brain, muscle, and tumor slices. The initial effect on liver slices from well-nourished rats is a stimulation of oxygen consumption followed by a fall. The stimulation disappears if iodoacetate is added with the selenite, or if the rat is fasted 24 hours before removing the liver.

2. Selenite-poisoned tissues are not able to oxidize glucose or succinic, lactic, pyruvic, or citric acids, but rapidly oxidize p-phenylenediamine.

3. Reduced glutathione added with the selenite protects the tissues against the depressant action of selenite. Pyruvic acid added in sufficient concentration will also maintain oxygen consumption if added at the same time as the selenite. Delayed addition of glutathione or pyruvic acid does not restore oxygen consumption lost from contact with selenite.

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THE ASSAY OF URINE IN CANINE BLACKTONGUE BY THE USE OF *Shigella paradysenteriae* (SONNE)

By H. F. Fraser, *Passed Assistant Surgeon*, N. H. Topping, *Assistant Surgeon*, and W. H. Sebrell, *Surgeon, United States Public Health Service, National Institute of Health*

Early in 1937 Knight (*1*) showed that vitamin B_1 plus nicotinic acid could completely replace the "staphylococcus growth factor" for 12 strains of *Staphylococcus aureus* in a medium of known chemical composition. Since the appearance of Knight's original paper, several workers have shown that other organisms require nicotinic acid. Among these, Koser and his associates (*2*) found that *Shigella paradysenteriae* (Flexner) and *Shigella paradysenteriae* (Sonne) require nicotinic acid.

Shortly after Knight's paper, Elvehjem et al. (*3*) showed that nicotinic acid would cure canine blacktongue, and Sebrell et al. (*4*), in 1938, reported that canine blacktongue could be prevented by adequate doses of nicotinic acid for a period of six months. Woolley et al. (*5*) later investigated a large number of compounds closely related to nicotinic acid for their blacktongue-curative activity. They found nicotinamide, diethyl nicotinamide, nicotinuric acid, etc., to be active in the cure of blacktongue. Dorfman et al. (*6*) observed that nicotinic acid, nicotinamide, methyl nicotinate, trigonelline amide, ethyl nicotinate, nicotinuric acid, etc., had growth supporting properties for certain bacteria in a synthetic basal medium.

It is conceivable that dogs on an adequate diet might excrete appreciable amounts of nicotinic acid, its derivatives, or closely

related compounds, while dogs on a blacktongue-producing diet might excrete much smaller amounts of these substances. Therefore, it was decided to use a modification of Knight's medium and technique for a biological assay for one or more substances in urine which would support growth of one of the organisms requiring nicotinic acid or related compounds in a basal synthetic medium complete except for nicotinic acid. With this in mind various cultures were tested both for their nicotinic acid requirement and for their ability to produce a turbidity of even distribution in order to facilitate readings. A culture of *Shigella paradysenteriae* (Sonne N. I. H. 741) was found to be suitable for this purpose.

EXPERIMENTAL

Six healthy young adult dogs (five males and one female) were selected for the experiment. Three of these animals (376, 381, 401) were given varying amounts of crystalline thyroxin while on diet 123.[1] This did not appear to influence the results of this experiment.

Technique of urine collection.—The dogs were walked for approximately 15 minutes or until they voluntarily voided. The animal was then given, by stomach tube, as much water as it appeared to be able comfortably to retain (400–700 cc) and placed in a metabolism cage, and urine was collected for a period of 4 hours. The five male dogs were catheterized and all residual urine was withdrawn at the end of the 4-hour period. The collected urine was measured for total volume and specific gravity. It was then filtered (Berkfeld N) and an aliquot portion stored in a refrigerator for the biological assay.

[1] Composition of blacktongue-producing diets:

Nutrients	Diet number		
	123	502	503
	Grams	*Grams*	*Grams*
Corn meal*	400	65	65
Cornstarch*		420	6
Cowpeas*	50	50	50
Sugar	32		
Casein, leached	60	60	60
Lard*		6	177
Cottonseed oil*	30	6	6
Cod liver oil	15	12	12
Salt mixture		26	26
Calcium carbonate	3		
Sodium chloride*	10		

Supplements:
0.2 mg synthetic vitamin B_1 bi-weekly, diets 502 and 503.
0.05 mg synthetic vitamin B_1 daily, diet 123.
0.5 mg riboflavin to each dog for 3 weeks beginning June 8, 1938, on diets 502 and 503.
Stock diet 326 consists of the following: graham flour,* 380 grams; whole milk powder, 120 grams; dried pork liver, 60 grams; brewers' yeast, 20 grams; cod liver oil, 10 grams; calcium carbonate, 6 grams; and sodium chloride,* 6 grams.
Each day the food served to every dog is weighed, the following day the residue deducted and the net food intake recorded.
*These items are stirred into water and cooked in a double boiler of enamelware for about 1½ hours, except for cornstarch, which is cooked for 20 minutes. Then the other ingredients are well stirred in, the total weight being brought to 2,400 grams with water (so that 1 gram represents 1 calorie), and this finished mixture is fed to the dog ad libitum.

Experimental status of animals at the time of urine collection.—A sample of urine was collected from each dog at the beginning of the experiment while on stock diet 326.[2] The animals were then placed on blacktongue-producing diet 123 [2] and a second sample of urine was collected from five dogs when they had definite symptoms of blacktongue (from the sixth dog after 52 days on the experimental diet). A third specimen was obtained from four dogs after the symptoms of blacktongue had entirely disappeared following return to stock diet 326. Two of these dogs were also given nicotinic acid therapy. Later, another 4-hour urine specimen was obtained from these four dogs 1 hour following the administration of 5 mg per kilo of body weight of nicotinic acid in distilled water given intramuscularly. A final urine specimen was then collected from 48 to 72 hours later.

Bacteriological technique.—The sample of urine to be tested was added to the basal media [3] in ascending dilutions from 0.1 cc of undiluted urine through the dilutions 1:10, 1:20, etc., to 1:1280. This basal medium, plus the dilutions of urine, was then autoclaved for 15 minutes at 15 pounds' pressure. The tubes, after cooling, were inoculated with a small loopful of a suspension of *Shigella paradysenteriae* (Sonne) prepared by touching a 24–48 hour agar slant of the organism with a straight wire and suspending in 5 cc of saline.

[2] See footnote 1.

[3] *Preparation of media.*[a]—Nutrient solution I is prepared as follows:

Substance	Amount/1,000 cc	Substance	g/1,000 cc
KH_2PO_4	4.5 g	S-aspartic acid	0.18
Water	550.0 ml	d-glutamic acid	.09
N/1 NaOH	25.0 ml	S-methionine	.07
S-alanine	.12 g	S-phenylalanine	.08
S-valine	.15 g	l-tyrosine	.05
S-leucine	.17 g	d-arginine HCl	.05
S-glycine	.05 g	l-histidine HCl	.05
l-proline	.07 g	S-lysine HCl	.09
l-oxyproline	.08 g		

The amino acids are dissolved, the pH is brought to 7.4, and the volume is adjusted to 600 ml. The solution is placed in 200-cc flasks, stoppered, autoclaved, and stored in a refrigerator.

The number of tubes, each finally to contain 1 ml, is computed. For example, say 100 tubes; this will amount to 100 cc of media, which will be composed of the following:

Substance	*Concentration*	*Amount*
Nutrient solution I		60 ml
Vitamin B_1	10^{-4} M in H_2O	10 ml
Ferrous ammonium sulfate [b]	M/500 in N/50 HCl	2.5 ml
Dithiodiglycollic acid (Na salt) [c]	M/10 SH	2.0 ml
Glucose [b]	M2	2.5 ml
H_2O	Triple distilled	13.0 ml
	Total	90.0 ml

This solution is then divided into the 100 tubes, each tube receiving 0.9 ml. Finally, the tubes each receive 0.1 ml of urine dilutions, or nicotinamide [d] (1×10^{-6}) dilutions. Certain control tubes receive 0.1 ml of triple distilled water.

The tubes are then plugged, autoclaved for 15 minutes at 15 pounds' pressure, and, after cooling, are ready for inoculation.

[a] Modification of basal media originally developed by Fildes et al. (Brit. J. Exp. Path., 17: 481 (1936)).
[b] Prepared freshly for each test.
[c] Prepared by Dr. Floyd S. Daft, Division of Chemistry, National Institute of Health.
[d] Specially purified and furnished by courtesy of Merck & Co.

After the tubes had been inoculated, they were incubated at 37° C. for about 20 hours, and the presence or absence of growth was read at once. The readings were made by comparing the gross turbidity produced by the growth of the organism in the tubes containing media plus urine dilutions with tubes containing media plus dilutions of either nicotinic acid or nicotinamide. Controls were included in each test for the sterility of the urine, sterility of the basal medium, and for the nicotinic acid requirements of the organism. In no test has there ever been perceptible growth of the Sonne bacillus in the basal medium without the addition of one of the growth supporting substances (i. e., nicotinic acid, nicotinamide, or urine). The results are summarized in table 1.

DISCUSSION

Table 1.—This table reveals a marked and consistent decrease in the bacterial growth promoting properties of the urine collected from all six dogs after 31 to 52 days on the blacktongue-producing diet. In one instance (dog 401) this was observed even though the animal showed no clinical signs of blacktongue after 52 days on the blacktongue-producing diet. This animal was then returned to stock diet 326 for a period of 15 days. Two dogs with blacktongue (358, 376) were treated with nicotinic acid and then returned to stock diet 326 for 12 and 20 days, respectively. Urine collected from these three dogs at that time showed bacterial growth promoting properties comparable to that observed before starting the blacktongue-producing diet. One dog (381) that developed blacktongue was returned to stock diet 326 for a period of 14 days without nicotinic acid treatment. Urine collected at that time demonstrated less bacterial growth promoting value than the specimen collected before starting the experimental diet. This is consistent with the observation that the urine of dogs 358 and 376, receiving both nicotinic acid and stock diet 326, gave a titration comparable to that at the beginning of the experiment.

Four of the animals (358, 376, 387, 401) were given an intramuscular injection of 5 mg of nicotinic acid per kilo of body weight and the urine manifested a marked increase in bacterial growth promoting properties, considerably above that shown by animals when on stock diet alone. Another specimen taken from the same animals from 48 to 72 hours later demonstrated a return to a level comparable to that on stock diet previous to the administration of nicotinic acid.

In order to avoid possible differences in rate and amount of bacterial growth at different times, all of the samples from any one dog were run simultaneously. In addition, the first and second urine samples from all of the dogs were run concurrently, and, as a further check, all urine samples from all dogs, except the two that died of blacktongue, were run at the same time under identical conditions.

TABLE 1.—*Results of incubation of inoculated and control tubes*

DOG NO. & SEX	DIET NO.	DAYS ON DIET	DATE (1938) URINE COLLECTED AND CLINICAL CONDITION	URINE DILUTIONS WITH READINGS OF VISIBLE BACTERIAL GROWTH. .1cc	1:10	1:20	1:40	1:80	1:160	1:320	1:640	1:1280	UN-INOC.	REMARKS	CC. WATER GIVEN	CC. URINE COLLECTED	SPECIFIC GRAVITY
393 ♂	326	98	6/25 NORMAL	++++	+++	++	++	+	0	0	0	0	0	7/21 FIRST SIGN OF BLACKTONGUE.	400	230	1.000
"	123	31	7/25 EARLY BLACKTONGUE	++++	++	±	0	0	0	0	0	0	0		400	300	1.001
399 ♂	326	22	6/24 NORMAL	++++	+++	+++	++	+	0	0	0	0	0	7/21 FIRST SIGN OF BLACKTONGUE.	600	600	1.000
"	123	31	7/25 MOD. ADVANCED BLACKTONGUE	+++	++	0	0	0	0	0	0	0	0		600	300	1.000
358 ♂	326	98	6/24 NORMAL	++++	+++	+++	++	+	±	0	0	0	0	7/21 FIRST SIGN OF BLACKTONGUE.	700	600	1.000
"	123	48	8/11 MOD. ADVANCED BLACKTONGUE	+++	+	0	0	0	0	0	0	0	0	8/12 GIVEN 40 MG. NICOTINIC ACID. 8/18 MOUTH NORMAL	700	700	1.002
"	326	12	8/24 NORMAL	++++	+++	++	+	±	0	0	0	0	0		500	310	1.000
"	326	19	8/31 NORMAL	++++	++++	++++	+++	++	++	+	+	±	0	GIVEN 5 MG/KILO (52.5 MG) NIC. ACID 1 HR. BEFORE URINE COL.	500	445	1.001
"	326	22	9/3 NORMAL	++++	+++	++	+	±	0	0	0	0	0		500	440	1.005
376 ♂	326	99	6/23 NORMAL	++++	+++	+++	++	+	±	0	0	0	0		600	460	1.001
"	123	46	8/9 EARLY BLACKTONGUE	+++	+	0	0	0	0	0	0	0	0	8/11 GIVEN 40 MG. 8/12 AND 8/13 GIVEN 50 MG. NIC. ACID.	625	350	1.000
"	326	20	8/30 NORMAL	++++	+++	++	+	+	±	0	0	0	0		600	555	1.000
"	326	21	9/1 NORMAL	++++	++++	+++	++	++	+	+	±	0	0	GIVEN 5 MG./KILO (44 MG.) NIC. ACID 1 HR. BEFORE URINE COL.	600	465	1.000
"	326	23	9/3 NORMAL	++++	++	+	±	±	0	0	0	0	0		600	505	1.004
381 ♀	326	98	6/23 NORMAL	++++	+++	+++	++	++	+	±	0	0	0		500	330	1.001
"	123	46	8/9 EARLY BLACKTONGUE	+++	+	0	0	0	0	0	0	0	0	8/2 FIRST SIGN OF BLACKTONGUE. 8/10 BEGINS STOCK DIET 326.	460	265	1.002
"	326	14	8/24 NORMAL	+++	++	±	0	0	0	0	0	0	0		500	145	1.000
"	326	21	8/31 NORMAL	++++	++++	+++	++	++	+	±	0	0	0	GIVEN 5 MG./KILO (33 MG.) NIC. ACID 1 HR. BEFORE URINE COL.	500	255	1.003
"	326	24	9/3 NORMAL	++++	++	+	±	0	0	0	0	0	0		500	380	1.004
401 ♂	326	22	6/23 NORMAL	++++	++++	+++	++	+	±	0	0	0	0		550	455	1.002
"	123	52	8/15 NORMAL	+++	+	±	0	0	0	0	0	0	0	SOME ANOREXIA--BEGINS STOCK DIET 326	490	210	1.000
"	326	15	8/30 NORMAL	++++	+++	++	++	+	0	0	0	0	0		500	460	1.000
"	326	16	9/1 NORMAL	++++	++++	+++	+++	++	++	+	+	±	0	GIVEN 5 MG./KILO (41 MG.) NIC. ACID 1 HR. BEFORE URINE COL.	500	250	1.002
"	326	18	9/3 NORMAL	++++	+++	++	++	+	0	0	0	0	0		500	600	1.003

READINGS OF VISIBLE BACTERIAL GROWTH ON CONTROLS	DILUTIONS .1cc	1:10	1:20	1:40	1:80	1:160	1:320	1:640	1:1280	1:2560
NICOTINAMIDE 1×10^{-6}	++++	++++	+++	+++	++	++	+	±	0	0
MEDIA + NICOTINAMIDE 1×10^{-6}	0	0	0	0	0					
UNINOCULATED MEDIA ALONE, INOC.	0	0	0	0	0					

Supplementary observations on animals on stock diet and other blacktongue-producing diets.—Even though the urine of depleted dogs on blacktongue-producing diet 123 produced the results given in table 1, it is possible that other blacktongue-producing diets would show no correlation between the clinical condition and urinary findings. Therefore, the urine of dogs on a high carbohydrate and on a high fat blacktongue-producing diet was investigated. A random sample of urine was taken from each of two dogs (384, 405) in an acute attack of blacktongue after 34 and 37 days, respectively, on diet 503.[4] These samples showed definitely less bacterial growth promoting ability than a 24-hour sample from two control dogs (353, 388) on stock diet 326, run simultaneously.

A 24-hour urine specimen from one dog (392), after 5 days on diet 503, showed bacterial growth promoting value comparable to urine from dogs on diet 326 (visible growth at dilution 1:160), but after 20 days on the diet, although there were no clinical signs of blacktongue, visible bacterial growth decreased to a dilution of 1:40. This result, together with that obtained on dog 401 (table 1), indicates that there is a decrease in the excretion of the bacterial growth promoting substances in urine preceding the development of the clinical signs of blacktongue.

A 24-hour urine specimen from one dog (409), taken 2 days after beginning the blacktongue-producing diet 502,[4] showed a bacterial growth promoting value comparable to urine from two dogs on stock diet 326 (visible growth in dilution 1:320). Eighteen days later, bacterial growth was visible only in dilution of 1:80, and 28 days from the beginning of the experiment, when the dog showed early clinical signs of blacktongue, bacterial growth was visible only in dilution of 1:40. Two days later, although the clinical signs of blacktongue persisted, the urine gave visible bacterial growth in dilution of 1:160. However, this animal unexpectedly made a spontaneous recovery, and within 4 days the clinical signs of blacktongue had entirely disappeared without treatment or change of diet. Furthermore, although this animal was continued on the diet for an additional 40 days and then sacrificed, post-mortem examination revealed no gross evidence of blacktongue.

General.—We have not attempted to estimate nicotinic acid quantitatively in dogs' urine by this test because we have no direct evidence that the substances being tested in this experiment are nicotinic acid or its derivatives. However, the observation that there was a marked increase in the bacterial growth promoting power of the urine following the administration of nicotinic acid, as well as the marked decrease in the growth promoting value of the urine of dogs with blacktongue,

[4] See footnote 1.

suggests that the principal factor concerned in this experiment is nicotinic acid or related compounds.

In every instance there has been a close correlation between the results of the biological assay and the clinical condition of the animal. Therefore, it appears that this test may be utilized to study some of the aspects of canine blacktongue.

CONCLUSIONS

1. A method for assaying the bacterial growth promoting properties of urine by the use of *Shigella paradysenteriae* (Sonne), which requires nicotinic acid or its related compounds, is presented.

2. Results obtained with urine from dogs on stock diet and blacktongue-producing diets indicate that this test may be correlated with the clinical condition of the animal.

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DEATHS DURING WEEK ENDED SEPTEMBER 24, 1938 [1]

[From the Weekly Health Index, issued by the Bureau of the Census, Department of Commerce]

	Week ended Sept. 24, 1938	Corresponding week, 1937
Data from 87 large cities of the United States:		
Total deaths	7,321	[2] 7,597
Average for 3 prior years	[2] 7,069	
Total deaths, first 38 weeks of year	306,874	330,587
Deaths under 1 year of age	496	[3] 505
Average for 3 prior years	[3] 495	
Deaths under 1 year of age, first 38 weeks of year	19,933	21,340
Data from industrial insurance companies:		
Policies in force	68,268,220	69,872,337
Number of death claims	10,891	11,867
Death claims per 1,000 policies in force, annual rate	8.3	8.9
Death claims per 1,000 policies, first 38 weeks of year, annual rate	9.3	9.9

[1] The figures presented in the table appearing in the Public Health Reports for Sept. 30, p. 1748, were for the week ended Sept. 10 instead of Sept. 17 as published.
[2] Data for 86 cities.
[3] Data for 85 cities.

PREVALENCE OF DISEASE

No health department, State or local, can effectively prevent or control disease without knowledge of when, where, and under what conditions cases are occurring

UNITED STATES

CURRENT WEEKLY STATE REPORTS

These reports are preliminary, and the figures are subject to change when later returns are received by the State health officers.

In these and the following tables, a zero (0) indicates a positive report and has the same significance as any other figure, while leaders (------) represent no report, with the implication that cases or deaths may have occurred but were not reported to the State health officer.

Cases of certain diseases reported by telegraph by State health officers for the week ended Oct. 1, 1938, rates per 100,000 population (annual basis), and comparison with corresponding week of 1937 and 5-year median

Division and State	Diphtheria				Influenza				Measles			
	Oct. 1, 1938, rate	Oct. 1, 1938, cases	Oct. 2, 1937, cases	1933–37 median	Oct. 1, 1938, rate	Oct. 1, 1938, cases	Oct. 2, 1937, cases	1933–37 median	Oct. 1, 1938, rate	Oct. 1, 1938, cases	Oct. 2, 1937, cases	1933–37 median
NEW ENG.												
Maine	6	1	1	1	6	1	------	------	6	1	8	3
New Hampshire	0	0	0	0	------	------	------	------	------	------	1	1
Vermont	0	0	0	0	------	------	------	------	------	------	6	6
Massachusetts	4	3	1	8	------	------	------	------	61	52	11	12
Rhode Island	0	0	0	1	------	------	------	------	------	------	------	2
Connecticut	3	1	3	3	9	3	2	1	12	4	5	5
MID. ATL.												
New York	5	13	23	27	[1] 1	[1] 2	[1] 12	[1] 11	24	60	115	60
New Jersey	7	6	7	15	14	12	9	9	6	5	24	18
Pennsylvania	7	14	19	39	------	------	------	------	24	46	234	30
E. NO. CEN.												
Ohio	25	32	33	40	------	------	15	19	18	23	94	20
Indiana	44	29	28	29	32	21	14	15	3	2	3	3
Illinois	17	26	35	35	8	12	9	9	15	22	45	15
Michigan [2]	12	11	24	19	------	------	2	2	56	52	15	20
Wisconsin	0	0	2	2	41	23	35	20	98	55	28	33
W. NO. CEN.												
Minnesota	22	11	3	4	10	5	------	------	73	37	6	7
Iowa	63	31	5	7	10	5	5	------	12	6	3	3
Missouri	33	25	38	45	14	11	22	28	4	3	15	15
North Dakota	22	3	0	2	37	5	------	------	465	63	------	4
South Dakota	8	1	0	1	15	2	------	------	73	10	------	1
Nebraska	27	7	0	5	------	------	------	------	8	2	4	1
Kansas	17	6	5	7	3	1	2	------	17	6	2	3

See footnotes at end of table.

Cases of certain diseases reported by telegraph by State health officers for the week ended Oct. 1, 1938, rates per 100,000 population (annual basis), and comparison with corresponding week of 1937 and 5-year median—Continued

Division and State	Diphtheria				Influenza				Measles			
	Oct. 1, 1938, rate	Oct. 1, 1938, cases	Oct. 2, 1937, cases	1933–37 median	Oct. 1, 1938, rate	Oct. 1, 1938, cases	Oct. 2, 1937, cases	1933–37 median	Oct. 1, 1938, rate	Oct. 1, 1938, cases	Oct. 2, 1937, cases	1933–37 median
SO. ATL.												
Delaware	60	3	0	0								
Maryland [2 3]	6	2	9	13	12	4	3	3	28	9	2	6
Dist. of Col	33	4	2	10	17	2			25	3	3	2
Virginia	96	50	39	39	145	75			12	6	16	8
West Virginia	59	21	34	45	34	12	5	7	14	5	9	6
North Carolina [3 4]	158	106	139	104	3	2	1	5	70	47	21	12
South Carolina [4]	120	43	23	23	667	240	122	142	8	3		1
Georgia [4]	63	37	52	52	93	55			17	10		
Florida [4]	31	10	22	12			3		50	16		1
E. SO. CEN.												
Kentucky	77	43	24	50	45	25	3	1	21	12	12	9
Tennessee [4]	61	34	39	47	61	34	13	11	4	2	47	14
Alabama [4]	140	78	29	48	50	28	24	9	13	7	1	5
Mississippi [3]	85	33	17	30								
W. SO. CEN.												
Arkansas [3]	59	23	20	14	64	25	5	5	3	1	3	2
Louisiana [4]	34	14	14	16	12	5	3	3	54	22	1	1
Oklahoma	25	12	7	12	76	37	31	27	8	4	1	1
Texas [4]	36	43	40	40	91	108	135	45	11	13	13	10
MOUNTAIN												
Montana	0	0	0	2	39	4		8	203	21	16	4
Idaho	0	0	0	0	32	3	4	2	11	1		
Wyoming	44	2	0	0					133	6	9	2
Colorado	122	25	18	4					34	7	8	5
New Mexico	37	3	2	2					37	3	7	4
Arizona	25	2	6	2	202	16	18	10	38	3	3	4
Utah [3]	10	1	2	0			10		20	2	95	1
PACIFIC												
Washington	3	1	4	3					28	9	6	13
Oregon	20	4	0	0	36	7	11	18	41	8	8	8
California	34	40	15	29	13	15	16	24	110	130	18	47
Total	34	854	784	984	40	800	534	534	33	799	918	672
39 weeks	19	18, 253	16, 979	22, 422	63	49, 189	276, 830	143, 202	804	764, 564	245, 396	344, 747

Division and State	Meningitis, meningococcus				Poliomyelitis				Scarlet fever			
	Oct. 1, 1938, rate	Oct. 1, 1938, cases	Oct. 2, 1937, cases	1933–37 median	Oct. 1, 1938, rate	Oct. 1, 1938, cases	Oct. 2, 1937, cases	1933–37 median	Oct. 1, 1938, rate	Oct. 1, 1938, cases	Oct. 2, 1937, cases	1933–37 median
NEW ENG.												
Maine	0	0	1	0	0	0	8	6	24	4	4	4
New Hampshire	0	0	0	0	0	0	0	0	31	3	3	3
Vermont	0	0	0	0	0	0	2	2	95	7	3	5
Massachusetts	1.2	1	0	1	2.4	2	16	13	47	40	64	64
Rhode Island	0	0	0	0	0	0	0	0	23	3	8	10
Connecticut	3	1	0	0	15	5	8	7	30	10	19	13
MID. ATL.												
New York	0.8	2	9	6	2.8	7	45	45	50	125	128	130
New Jersey	1.2	1	0	0	1.2	1	12	12	30	25	45	38
Pennsylvania	1	2	4	4	1.5	3	31	15	36	71	149	168

See footnotes at end of table.

Cases of certain diseases reported by telegraph by State health officers for the week ended Oct. 1, 1938, rates per 100,000 population (annual basis), and comparison with corresponding week of 1937 and 5-year median—Continued

Division and State	Meningitis, meningococcus				Poliomyelitis				Scarlet fever			
	Oct. 1, 1938, rate	Oct. 1, 1938, cases	Oct. 2, 1937, cases	1933–37 median	Oct. 1, 1938, rate	Oct. 1, 1938, cases	Oct. 2, 1937, cases	1933–37 median	Oct. 1, 1938, rate	Oct. 1, 1938, cases	Oct. 2, 1937, cases	1933–37 median
E. NO. CEN.												
Ohio	0.8	1	3	3	3	4	40	27	118	152	238	238
Indiana	0	0	1	1	1.5	1	8	7	134	89	85	85
Illinois	0	0	3	3	4	6	72	15	91	133	161	161
Michigan [2]	1.1	1	1	1	2.2	2	44	14	198	183	163	92
Wisconsin	0	0	1	1	0	0	34	7	143	80	44	76
W. NO. CEN.												
Minnesota	0	0	0	0	0	0	28	4	106	54	24	24
Iowa	0	0	0	1	2	1	18	3	51	25	66	41
Missouri	0	0	3	2	0	0	20	2	106	81	146	51
North Dakota	7	1	0	0	0	0	0	0	96	13	8	11
South Dakota	0	0	0	0	8	1	2	2	23	3	9	9
Nebraska	0	0	2	0	0	0	18	1	50	13	11	13
Kansas	0	0	0	0	0	0	26	4	196	70	61	40
SO. ATL.												
Delaware	0	0	0	0	0	0	0	0	40	2	10	9
Maryland [2 3]	9	3	3	1	3	1	7	5	25	8	36	36
Dist. of Col	0	0	0	0	0	0	2	1	67	8	4	14
Virginia	0	0	1	1	1.9	1	1	2	71	37	23	34
West Virginia	2.8	1	1	1	2.8	1	2	4	134	48	57	73
North Carolina [3 4]	0	0	3	0	0	0	2	2	124	83	88	88
South Carolina [4]	0	0	1	0	2.8	1	0	0	36	13	7	8
Georgia [4]	0	0	2	2	0	0	2	0	39	23	27	20
Florida [4]	0	0	0	0	0	0	0	0	25	8	2	2
E. SO. CEN.												
Kentucky	0	0	4	4	0	0	2	3	127	71	57	57
Tennessee [4]	0	0	1	1	0	0	4	4	88	49	41	55
Alabama [4]	5	3	0	2	7	4	1	1	54	30	23	23
Mississippi [3]	0	0	1	1	0	0	8	0	28	11	13	15
W. SO. CEN.												
Arkansas [3]	0	0	3	0	0	0	12	1	23	9	15	13
Louisiana [4]	2.4	1	0	1	0	0	3	1	12	5	4	5
Oklahoma	2	1	1	1	4	2	21	1	41	20	14	12
Texas [4]	0	0	2	0	1.7	2	26	3	43	51	50	31
MOUNTAIN												
Montana	0	0	1	0	0	0	3	1	203	21	9	9
Idaho	0	0	0	0	0	0	1	0	74	7	10	9
Wyoming	0	0	0	0	0	0	1	0	67	3	3	4
Colorado	0	0	0	0	0	0	31	1	93	19	18	18
New Mexico	0	0	0	0	0	0	0	1	49	4	10	10
Arizona	0	0	0	0	0	0	0	1	38	3	2	6
Utah [3]	0	0	0	0	0	0	3	1	50	5	16	7
PACIFIC												
Washington	0	0	0	0	0	0	6	6	31	10	18	19
Oregon	0	0	0	1	0	0	3	3	117	23	10	22
California	0.8	1	1	1	6	7	30	25	94	111	119	118
Total	0.8	20	53	52	2.1	52	603	316	76	1,871	2,125	2,210
39 weeks	2.4	2,337	4,499	4,499	1.4	1,354	7,724	5,807	149	144,157	172,584	172,584

See footnotes at end of table.

Cases of certain diseases reported by telegraph by State health officers for the week ended Oct. 1, 1938, rates per 100,000 population (annual basis), and comparison with corresponding week of 1937 and 5-year median—Continued

Division and State	Smallpox				Typhoid and paratyphoid fever				Whooping cough	
	Oct. 1, 1938, rate	Oct. 1, 1938, cases	Oct. 2, 1937, cases	1933–37 median	Oct. 1, 1938, rate	Oct. 1, 1938, cases	Oct. 2, 1937, cases	1933–37 median	Oct. 1, 1938, rate	Oct. 1, 1938, cases
NEW ENG.										
Maine	0	0	0	0	12	2	3	3	110	18
New Hampshire	0	0	0	0	0	0	0	0	0	0
Vermont	0	0	0	0	0	0	6	0	204	15
Massachusetts	0	0	0	0	2	2	3	3	92	78
Rhode Island	0	0	0	0	23	3	1	0	69	9
Connecticut	0	0	0	0	6	2	2	1	111	37
MID ATL.										
New York	0	0	0	0	11	27	29	26	194	481
New Jersey	0	0	0	0	6	5	11	11	225	187
Pennsylvania	0	0	0	0	9	17	41	41	95	186
E. NO. CEN.										
Ohio	1	1	1	0	13	17	49	49	177	228
Indiana	3	2	2	0	26	17	2	9	27	18
Illinois	0	0	1	1	19	29	29	29	221	334
Michigan [1]	1	1	0	0	4	4	11	11	293	271
Wisconsin	0	0	1	1	4	2	2	2	511	287
W. NO. CEN.										
Minnesota	4	2	4	0	8	4	4	4	88	45
Iowa	14	7	6	0	2	1	11	11	33	16
Missouri	0	0	1	0	12	9	41	17	25	19
North Dakota	0	0	3	3	7	1	1	2	162	22
South Dakota	0	0	0	1	23	3	2	2	8	1
Nebraska	0	0	0	0	0	0	0	0	57	15
Kansas	6	2	0	0	14	5	8	8	137	49
SO. ATL.										
Delaware	0	0	0	0	0	0	2	2	320	16
Maryland [2] [3]	0	0	0	0	25	8	14	17	53	16
Dist. of Col.	0	0	0	0	42	5	1	2	141	17
Virginia	0	0	1	0	37	19	18	20	102	53
West Virginia	0	0	1	0	42	15	14	25	81	29
North Carolina [3] [4]	0	0	0	0	7	5	22	24	230	154
South Carolina [4]	0	0	0	0	42	15	11	20	195	70
Georgia [4]	0	0	2	0	17	10	9	19	12	7
Florida [4]	0	0	0	0	9	3	4	4	41	13
E. SO. CEN.										
Kentucky	0	0	3	1	18	10	25	43	45	25
Tennessee [4]	0	0	1	0	14	8	11	33	65	36
Alabama [4]	2	1	1	0	7	4	6	22	36	20
Mississippi [3]	5	2	0	0	18	7	19	8	------	------
W. SO. CEN.										
Arkansas [3]	0	0	0	0	25	10	18	10	15	6
Louisiana [4]	0	0	0	0	54	22	17	19	17	7
Oklahoma	4	2	2	0	10	5	12	17	14	7
Texas [4]	1	1	1	1	29	34	31	41	68	81
MOUNTAIN										
Montana	0	0	5	0	29	3	6	6	184	19
Idaho	0	0	6	0	11	1	4	4	63	6
Wyoming	0	0	0	0	0	0	2	1	67	3
Colorado	29	6	1	1	68	14	31	10	141	29
New Mexico	12	1	0	0	124	10	24	23	297	24
Arizona	25	2	0	0	51	4	0	0	101	8
Utah [3]	0	0	0	0	0	0	0	0	311	31
PACIFIC										
Washington	6	2	6	6	13	4	1	4	104	33
Oregon	20	4	1	0	5	1	4	4	46	9
California	2	2	1	0	17	20	12	12	89	105
Total	2	38	51	33	16	387	574	650	129	3,140
39 weeks	13	12,932	8,284	5,484	12	11,277	11,766	13,451	173	164,595

[1] New York City only.
[2] Period ended earlier than Saturday.
[3] Rocky Mountain spotted fever, week ended October 1, 1938, 3 cases as follows: Maryland, 1; North Carolina, 1; Arkansas, 1.
[4] Typhus fever, week ended October 1, 1938, 64 cases as follows: North Carolina, 1; South Carolina, 9; Georgia, 24; Florida, 1; Tennessee, 1; Alabama, 10; Louisiana, 1; Texas, 17.

SUMMARY OF MONTHLY REPORTS FROM STATES

The following summary of cases reported monthly by States is published weekly and covers only those States from which reports are received during the current week:

State	Meningitis, meningococcus	Diphtheria	Influenza	Malaria	Measles	Pellagra	Poliomyelitis	Scarlet fever	Smallpox	Typhoid fever
July 1938										
Hawaii Territory	0	5	17	1	17	----	0	----	0	7
New Hampshire	0	1	----	----	----	----	0	6	0	3
August 1938										
Arizona	1	24	61	3	31	2	0	4	3	12
California	12	78	49	106	675	10	29	282	38	52
Hawaii Territory	0	5	14	----	5	----	0	----	0	11
Louisiana	7	55	39	135	19	22	3	28	0	72
Massachusetts	4	8	----	2	261	2	4	120	0	11
Nevada	1	0	3	----	3	----	0	1	0	1
New Hampshire	0	0	----	----	----	----	0	----	0	1
North Dakota	2	2	12	----	41	----	3	18	7	0
Oregon	0	3	38	5	43	----	0	34	17	10
Vermont	0	1	----	----	22	----	2	9	0	5
Virginia	1	77	155	20	108	22	12	34	0	60
Washington	3	8	5	1	33	----	1	43	29	42

July 1938

	Cases
Hawaii Territory:	
Chickenpox	26
Dysentery (amoebic)	4
Hookworm disease	7
Impetigo contagiosa	21
Leprosy	1
Mumps	25
Ophthalmia neonatorum	4
Septic sore throat	1
Tetanus	2
Trachoma	2
Typhus fever	5
Whooping cough	62

August 1938

	Cases
Anthrax:	
Louisiana	2
North Dakota	1
Chickenpox:	
Arizona	6
California	237
Hawaii Territory	22
Louisiana	6
Massachusetts	99
Nevada	4
North Dakota	16
Oregon	33
Vermont	19
Virginia	9
Washington	77
Dysentery:	
Arizona	72
California (amoebic)	15
California (bacillary)	74
Hawaii Territory (amoebic)	3
Louisiana (amoebic)	7
Louisiana (bacillary)	6
Massachuserrs (amoebic)	1
Massachusetts (bacillary)	22
Virginia (diarrhea included)	820
Washington (bacillary)	4
Encephalitis:	
California	9
Louisiana	2
Massachusetts	1
North Dakota	28
Oregon	1
Washington	4
Food poisoning:	
California	89

August 1938—Continued

	Cases
German measles:	
Arizona	4
California	60
Massachusetts	34
North Dakota	1
Washington	7
Granuloma, coccidioidal:	
California	10
Hookworm disease:	
California	1
Hawaii Territory	1
Louisiana	8
Impetigo contagiosa:	
Hawaii Territory	25
Oregon	25
Jaundice, infectious:	
Oregon	3
Leprosy:	
California	1
Hawaii Territory	5
Mumps:	
Arizona	2
California	679
Hawaii Territory	33
Massachusetts	143
Nevada	3
Oregon	21
Vermont	26
Virginia	38
Washington	97
Ophthalmia neonatorum:	
California	2
Massachusetts	88
Paratyphoid fever:	
California	5
Louisiana	2
Massachusetts	10
Virginia	3
Rabies in animals:	
California	117
Louisiana	6
Oregon	6
Washington	28
Rabies in man:	
North Dakota	1
Relapsing fever:	
California	5
Rocky Mountain spotted fever:	
California	1
Massachusetts (delayed report)	1
Virginia	10
Scabies:	
Oregon	11
Septic sore throat:	
California	9

August 1938—Continued

	Cases
Septic sore throat—Con.	
Louisiana	14
Massachusetts	9
North Dakota	1
Oregon	6
Virginia	38
Washington	6
Tetanus:	
California	10
Louisiana	1
Massachusetts	3
Trachoma:	
Arizona	37
California	26
Hawaii Territory	1
Louisiana	1
North Dakota	8
Virginia	1
Trichinosis:	
California	5
Massachusetts	1
Tularaemia:	
California	2
Louisiana	4
Nevada	1
Oregon	2
Virginia	4
Typhus fever:	
California	2
Hawaii Territory	8
Louisiana	2
Virginia	1
Undulant fever:	
Arizona	2
California	29
Louisiana	3
Massachusetts	5
North Dakota	1
Oregon	3
Virginia	4
Washington	3
Vincent's infection:	
North Dakota	2
Oregon	5
Washington	1
Whooping cough:	
Arizona	79
California	906
Hawaii Territory	67
Louisiana	133
Massachusetts	309
Nevada	4
North Dakota	140
Oregon	77
Vermont	90
Virginia	164
Washington	179

PLAGUE INFECTION IN CALIFORNIA

IN POOLS OF FLEAS FROM GROUND SQUIRRELS AND IN A GROUND SQUIRREL IN SAN BERNARDINO AND ELDORADO COUNTIES

Under date of September 7, 1938, Doctor W. M. Dickie, Director of Public Health of California, reported plague infection proved in a pool of 39 fleas from 14 *fisheri* squirrels collected August 18, from Running Springs, 2 miles south, 4 miles east of Lake Arrowhead, San Bernardino County; and under date of September 15, in one *beecheyi* squirrel shot August 8, one mile northwest of Tallac, Fallen Leaf Lake, Eldorado County, and in a pool of 11 fleas from 3 *beecheyi* squirrels collected August 15, 2 miles south of Tallac, Fallen Leaf Lake, Eldorado County.

WEEKLY REPORTS FROM CITIES

City reports for week ended Sept. 24, 1938

This table summarizes the reports received weekly from a selected list of 140 cities for the purpose of showing a cross section of the current urban incidence of the communicable diseases listed in the table.

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Small pox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Data for 90 cities:											
5-year average	153	69	17	121	325	438	3	341	87	924	----
Current week [1]	99	157	10	222	305	367	2	313	48	1,344	----
Maine:											
Portland	0	----	0	0	2	0	0	0	0	2	31
New Hampshire:											
Concord	0	----	0	0	0	0	0	0	0	0	8
Manchester	0	----	0	0	0	3	0	0	0	0	13
Nashua	0	----	0	0	0	0	0	0	0	0	3
Vermont:											
Barre	0	----	0	1	0	3	0	0	0	0	1
Burlington	0	----	0	0	0	0	0	0	0	0	10
Rutland	0	----	0	0	0	0	0	0	0	0	3
Massachusetts:											
Boston	0	----	1	3	17	17	0	8	0	8	193
Fall River	1	----	0	0	1	0	0	1	0	1	36
Springfield	0	----	0	0	2	1	0	0	0	2	39
Worcester	0	----	0	2	3	0	0	1	0	13	42
Rhode Island:											
Pawtucket	0	----	0	0	7	0	0	0	0	0	16
Providence	0	----	0	0	1	1	0	0	0	13	77
Connecticut:											
Bridgeport	0	----	0	0	1	0	0	1	0	2	29
Hartford	0	----	0	2	0	1	0	0	0	1	31
New Haven	0	1	0	2	1	0	0	1	0	16	32
New York:											
Buffalo	1	----	0	1	3	7	0	5	0	22	127
New York	9	5	1	16	53	16	0	53	11	242	1,331
Rochester	0	----	0	5	1	0	0	2	0	3	54
Syracuse	0	----	0	0	2	2	0	0	1	10	44
New Jersey:											
Camden	0	----	0	0	1	1	0	0	1	0	24
Newark	0	----	0	2	4	7	0	5	0	57	88
Trenton	0	----	0	0	5	0	0	0	0	1	28
Pennsylvania:											
Philadelphia	0	----	1	7	13	15	0	27	2	92	431
Pittsburgh	5	----	0	2	10	9	0	9	0	14	130
Reading	1	----	0	0	4	0	0	1	0	5	19
Scranton	1	----	----	0	----	3	0	----	0	0	----
Ohio:											
Cincinnati	1	----	0	0	0	7	0	1	1	9	110
Cleveland	1	5	0	5	2	8	0	16	0	36	142
Columbus	0	----	0	1	0	3	0	5	0	3	80
Toledo	0	----	0	1	4	9	0	5	0	2	68

[1] Figures for South Bend, Ind., and Tacoma, Wash., estimated; reports not received.

City reports for week ended Sept. 24, 1938—Continued

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Small pox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Indiana:											
Anderson	0	------	0	0	0	4	0	0	0	0	6
Fort Wayne	0	------	0	0	1	0	0	0	1	0	20
Indianapolis	3	------	0	0	11	5	1	3	2	6	98
Muncie	0	------	0	0	0	2	0	0	0	0	8
South Bend	------	------	------	------	------	------	------	------	------	------	------
Terre Haute	1	------	0	0	0	7	0	0	0	1	19
Illinois:											
Alton	0	------	0	0	0	0	0	0	1	0	4
Chicago	12	4	2	9	20	58	0	37	5	249	650
Elgin	0	------	0	0	1	0	0	0	0	0	13
Moline	0	------	0	0	0	0	3	0	0	0	7
Springfield	0	------	0	0	3	0	0	0	0	0	25
Michigan:											
Detroit	3	------	0	3	8	34	0	9	0	135	191
Flint	0	------	0	2	6	14	0	0	0	9	26
Grand Rapids	0	------	0	1	1	15	0	2	0	0	37
Wisconsin:											
Kenosha	0	------	0	0	0	1	0	0	0	7	10
Madison	0	------	0	1	0	4	0	0	0	1	5
Milwaukee	1	------	0	3	1	19	0	3	0	141	88
Racine	0	------	0	0	0	4	0	1	0	29	13
Superior	0	------	0	0	0	0	0	0	0	2	4
Minnesota:											
Duluth	0	------	0	0	1	1	0	0	0	6	20
Minneapolis	0	------	0	3	4	7	0	0	0	14	98
St. Paul	0	------	0	3	6	3	0	2	0	15	69
Iowa:											
Cedar Rapids	0	------	------	0	------	0	0	0	------	1	------
Davenport	1	------	------	0	------	0	0	0	------	0	------
Des Moines	0	------	0	0	0	0	0	0	0	0	29
Sioux City	0	------	------	1	------	2	0	0	------	1	------
Waterloo	7	------	------	0	------	2	0	------	0	0	------
Missouri:											
Kansas City	2	------	0	0	2	7	0	2	0	3	79
St. Joseph	0	------	0	0	0	2	1	2	0	1	14
St. Louis	3	1	0	0	6	2	0	10	5	10	150
North Dakota:											
Fargo	0	------	0	24	0	1	0	0	0	0	5
Grand Forks	0	------	------	0	------	0	0	------	0	0	------
Minot	1	------	0	0	0	0	0	0	0	0	5
South Dakota:											
Aberdeen	0	------	------	0	------	1	0	------	0	0	------
Sioux Falls	0	------	0	0	0	2	0	0	0	0	10
Nebraska:											
Lincoln	0	------	------	1	------	0	0	------	0	3	------
Omaha	1	------	0	0	3	0	0	1	0	0	53
Kansas:											
Lawrence	0	------	0	0	1	0	0	0	0	0	5
Topeka	0	------	0	0	1	5	0	0	0	6	17
Wichita	1	------	0	0	1	4	0	2	0	5	19
Delaware:											
Wilmington	0	------	0	0	1	0	0	1	0	0	27
Maryland:											
Baltimore	3	3	1	6	11	2	0	14	2	17	184
Cumberland	0	------	0	0	0	0	0	0	0	0	8
Frederick	0	------	0	0	0	0	0	0	0	0	4
Dist. of Col.:											
Washington	4	2	0	1	3	7	0	8	3	7	124
Virginia:											
Lynchburg	2	------	0	0	0	0	0	0	0	0	11
Norfolk	0	------	0	0	1	2	0	1	0	0	23
Richmond	4	------	0	2	2	4	0	1	1	1	38
Roanoke	1	------	0	0	0	1	0	0	1	0	9
West Virginia:											
Charleston	1	------	0	0	1	0	0	1	1	0	21
Huntington	3	------	------	0	------	1	0	------	0	0	------
Wheeling	0	------	0	2	1	0	0	3	0	1	14
North Carolina:											
Gastonia	1	------	------	0	------	0	0	------	0	0	------
Raleigh	1	------	0	0	1	0	0	0	0	0	13
Wilmington	1	------	0	0	1	0	0	0	0	1	12
Winston-Salem	1	------	0	1	1	4	0	2	0	0	14

City reports for week ended Sept. 24, 1938—Continued

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Small pox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
South Carolina:											
Charleston	0	3	----	0	0	0	0	1	0	6	17
Florence	0	----	0	0	1	0	0	0	0	4	12
Greenville	1	----	0	1	0	0	0	0	0	1	4
Georgia:											
Atlanta	7	110	0	0	2	7	0	5	0	5	68
Brunswick	0	----	0	0	0	0	0	0	1	0	4
Savannah	1	14	1	0	1	0	0	3	1	1	28
Florida:											
Miami	1	----	0	0	3	0	0	2	0	3	28
Tampa	1	----	0	0	0	1	0	0	0	4	24
Kentucky:											
Ashland	0	----	0	0	1	0	0	0	0	0	7
Covington	0	----	0	0	0	0	0	0	0	0	13
Lexington	1	----	0	0	1	1	0	1	0	0	21
Louisville	0	1	0	1	3	6	0	4	0	1	75
Tennessee:											
Knoxville	0	----	0	0	0	0	0	0	0	0	27
Memphis	1	1	0	0	9	4	0	3	1	4	92
Nashville	0	----	1	0	0	1	0	4	0	1	33
Alabama:											
Birmingham	0	1	0	0	8	1	0	3	0	0	71
Mobile	0	1	0	0	0	0	0	1	0	1	23
Montgomery	3	1	----	1	----	0	0	----	0	2	----
Arkansas:											
Fort Smith	2	----	----	0	----	0	0	----	0	0	----
Little Rock	0	----	0	0	1	0	0	1	0	0	2
Louisiana:											
Lake Charles	0	----	0	0	0	0	0	0	0	0	6
New Orleans	3	----	0	10	14	3	0	12	2	24	159
Shreveport	0	----	0	0	10	0	0	0	0	0	46
Oklahoma:											
Oklahoma City	1	3	----	0	1	4	0	0	0	0	29
Texas:											
Dallas	2	----	0	0	3	7	0	1	2	6	40
Fort Worth	0	----	0	0	1	12	0	0	0	8	39
Galveston	0	----	0	0	1	0	0	2	0	0	10
Houston	4	----	1	0	3	2	0	8	0	0	67
San Antonio	1	----	0	0	5	0	0	3	0	8	60
Montana:											
Billings	0	----	0	2	0	0	0	0	0	2	4
Great Falls	1	----	0	0	1	0	0	0	0	5	7
Helena	0	----	0	2	0	0	0	0	0	1	3
Missoula	0	----	0	0	0	1	0	0	0	0	7
Idaho:											
Boise	0	----	0	0	0	0	0	0	0	0	6
Colorado:											
Colo. Springs	0	----	0	0	1	0	0	3	0	10	14
Denver	4	----	1	3	4	7	0	4	0	12	98
Pueblo	0	----	0	0	0	0	0	0	1	3	4
New Mexico:											
Albuquerque	0	----	0	0	0	0	0	2	1	0	18
Utah:											
Salt Lake City	0	----	0	2	1	0	0	0	0	7	21
Washington:											
Seattle	0	----	0	2	4	7	0	2	0	8	79
Spokane	1	----	0	1	1	0	0	1	1	0	26
Tacoma	----	----	----	----	----	----	----	----	----	----	----
Oregon:											
Portland	0	----	0	3	3	12	6	4	0	3	76
Salem	0	1	----	0	----	2	0	----	0	1	----
California:											
Los Angeles	5	5	0	7	9	16	0	11	0	26	291
Sacramento	1	----	0	2	1	0	0	1	0	3	28
San Francisco	1	1	0	82	4	0	0	7	2	12	147

City reports for week ended Sept. 24, 1938—Continued

State and city	Meningitis, meningococcus		Poliomyelitis cases
	Cases	Deaths	
Massachusetts:			
Springfield	0	0	1
New York:			
New York	3	2	1
Rochester	0	0	1
New Jersey:			
Camden	1	0	0
Pennsylvania:			
Philadelphia	0	0	1
Ohio:			
Cleveland	1	0	1
Illinois:			
Alton	0	0	1
Michigan:			
Detroit	1	0	0
Minnesota:			
Duluth	0	0	1
Minneapolis	0	0	1
Missouri:			
St. Louis	0	0	1
North Dakota:			
Minot	0	1	0
District of Columbia:			
Washington	0	0	2
West Virginia:			
Wheeling	1	0	0
Alabama:			
Montgomery	0	0	1
Montana:			
Great Falls	0	0	3

Encephalitis, epidemic or lethargic.—Cases: New York, 2; St. Paul, 2; St. Louis, 1; Minot, 2; Louisville, 1; Billings, 1.

Pellagra.—Cases: Savannah, 3; Birmingham, 1; San Antonio, 1; Los Angeles, 1; San Francisco, 1.

Typhus fever.—Cases: Wilmington, N. C., 3; Charleston, S. C., 3; Atlanta, 2; Savannah, 5; Tampa, 3; Mobile, 2; Lake Charles, 1; Fort Worth, 2; Houston, 3.

FOREIGN AND INSULAR

CZECHOSLOVAKIA

Communicable diseases—June 1938.—During the month of June 1938, certain communicable diseases were reported in Czechoslovakia as follows:

Disease	Cases	Deaths	Disease	Cases	Deaths
Anthrax	3		Paratyphoid fever	10	
Cerebrospinal meningitis	42	7	Poliomyelitis	5	2
Chickenpox	176		Puerperal fever	19	10
Diphtheria	1,714	70	Scarlet fever	1,680	14
Dysentery	11	1	Trachoma	72	
Influenza	19	2	Typhoid fever	333	13
Lethargic encephalitis	2	2	Typhus fever	1	
Malaria	962				

FRANCE

Vital statistics—First quarter 1938—Comparative.—The French Ministry of National Economy has recently published the following vital statistics for the first quarter of 1938, with the figures for the first quarter of 1937 for comparison:

	1938	1937		1938	1937
Number of marriages	54,639	55,001	Number of deaths	192,937	177,671
Number of live births	157,253	158,605	Deaths under 1 year of age	10,457	11,606
Number of stillbirths	5,804	6,020			

GREAT BRITAIN

England and Wales—Smallpox—1901–1936.—The British Ministry of Health has recently published the numbers of cases of, and deaths from, smallpox for the years 1901 to 1936, reproduced in the accompanying table. The figures relate to civilians only, and include both virulent and non-virulent forms of smallpox. In 1917 the number of cases of smallpox fell to the low figure of 7 and then rose almost uninterruptedly until 1927, when 14,767 cases were reported. The number of cases then declined to 1 in 1935.[1] Since 1920, the majority of the cases have been of the non-virulent type. It is stated that, in 1936, all the cases notified were of the virulent type,

[1] It is stated that the diagnosis in this case was probably incorrect.

which led to the belief that, in many instances, the infection had been introduced from abroad. The report states that all of the outbreaks were checked and finally extinguished by prompt and vigorous action on the part of the health authorities. It also states that experience proved the virulent type of smallpox to be more easily conquered than the mild form, because in the former case the public is alarmed and willing to aid the health authorities in all control measures.

Year	Cases	Deaths	Year	Cases	Deaths
1901	1,980	356	1919	294	24
1902	13,923	2,464	1920	263	30
1903	7,383	760	1921	315	5
1904	5,766	507	1922	973	27
1905	2,338	116	1923	2,485	7
1906	1,020	21	1924	3,765	13
1907	127	10	1925	5,365	9
1908	22	12	1926	10,146	18
1909	87	21	1927	14,767	47
1910	108	19	1928	12,420	53
1911	295	23	1929	10,967	39
1912	123	9	1930	11,839	28
1913	115	10	1931	5,664	9
1914	64	4	1932	2,039	3
1915	90	13	1933	631	2
1916	149	16	1934	179	6
1917	7	3	1935	[1] 1	----
1918	63	2	1936	12	----

NOTE.—The population for England and Wales in 1901 was 15,555,319; in 1920, 37,609,000; in 1936, 40,839,000.

[1] Diagnosis believed to have been incorrect.

CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER

NOTE.—A table giving current information of the world prevalence of quarantinable diseases appeared in the PUBLIC HEALTH REPORTS for September 30, 1938, pages 1759–1773. A similar cumulative table will appear in future issues of the PUBLIC HEALTH REPORTS for the last Friday of each month.

Cholera

China.—During the week ended September 24, 1938, cases of cholera were reported in China as follows: Canton, 4; Hong Kong, 20; Shanghai, 113; Swatow, 2.

India—Rangoon.—During the week ended September 24, 1938, 1 case of cholera was reported in Rangoon, India.

Japan—Fukuyama.—During the week ended October 1, 1938, 3 cases of cholera were reported in Fukuyama, Japan.

Plague

Argentina.—For the period September 1–15, 1938, plague was reported in Argentina as follows: Ingenio Santa Ana, Tucuman Province, 2 cases, 1 death; Aguaray, Salta Province, 1 case, 1 death.

China—Manchuria.—According to information dated August 25, 1938, 17 cases of plague occurred in the Moli Tribe in South Hsingan Province, near Fengpu. Plague has also been reported at Wutaokoutzu in the Kaitung district, where 5 deaths occurred between August 13 and 17. Ten cases of plague with 10 deaths have also been

reported in the Li Chin Yu Tribe near Heitimiao in northern Kirin Province between July 29 and August 10, 1938.

Peru.—During the month of August 1938, plague has been reported in Peru as follows: Trujillo, Libertad Department, 1 case; Canete, Lima Department, 3 cases, 2 deaths.

United States—California.—A report of plague infection in Eldorado and San Bernardino Counties, California, appears on page 1848 of this issue of PUBLIC HEALTH REPORTS.

Smallpox

Colombia.—During the month of July 1938, smallpox was reported in Colombia as follows: Departments—Antioquia, 27 cases; Caldas, 57 cases; Cundinamarca, 19 cases; Magdalena, 9 cases; Narino, 3 cases; Tolima, 5 cases, 5 deaths; Valle del Cauca, 2 cases, 1 death. Intendencias and Commissaries, 2 cases, 2 deaths.

Dutch East Indies—Batavia.—During the week ended September 17, 1938, 1 imported case of smallpox with 1 death was reported in Batavia, Dutch East Indies.

Siam.—During the week ended September 24, 1938, 33 cases of smallpox were reported in Siam.

Yellow Fever

Gold Coast—Salaga.—On September 23, 1938, 2 cases of yellow fever were reported in Salaga, Gold Coast.

Sudan (French)—Kouy.—On September 23, 1938, 1 suspected fatal case of yellow fever was reported in Kouy, French Sudan.